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DEPARTMENT OF AGRICULTURE

IN THE WAR

By

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THE TASK AND THE TOOLS.

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When, in April, 1917, the United States of America became a party to the World War, the high spirit of the old Crusaders came out of the dust of dead centuries and stood again upon stricken fields against the infidel--infidel to the faith of human freedom.

Purer purpose was never more righteously wrought out to conclusion so glorious. The national purpose became the personal purpose. It permeated everywhere and inspired everything. The soldier alone in a shell hole out beyond the front-line trenches; the sailor adown the long lanes of an infested ocean; the scientist in his laboratory; the worker in foundry and forest, at ship yard and powder plant; the farmer between the plow handles in the rows of whispering corn; the woman, nursing wounded men in the glare of bursting shells, or scrimping two meals out of one in her kitchen at home, or knitting on into the night; the child, foregoing candy that the pennies might be saved for war stamps--from top to bottom and through and through, the Nation fought for nothing selfish and nothing sordid but for the simple right of all men everywhere to live their own lives, unhindered and unafraid.

The Department of Agriculture had share in it all. It claims merely to have done its duty, not more. And yet these many pages of type are required to tell the story in barest outline.

Work Felt on Every Hand.

For the story does not stop with the master task of stimulating the production of enough food to keep the allied world in fighting form. It goes to every branch of the fighting forces and to every nook of the supporting organizations. It is difficult to touch the army anywhere, foot, horse or dragoons, in camp or on the march or "going over the top," that the practical work of one bureau or another of the department was not felt. Every soldier, when he took up his mess plate; when he put on his shoes to march through mud and slush; when he went to bed under a tent that did not leak, with no "cooties" scourging under him and no rats running over him; when he ran into a gas pocket and came out with unshriveled lungs; whenever he turned and whatever he did, he reaped some benefit of the activities of the Department of Agriculture. For it inspected nearly every piece of meat that went to the Army and the Navy. It had men in its laboratories in Washington testing shoe leathers and methods of waterproofing them, and it had other men out through the hills and hollows and broad plains of the country instructing farmers how to take the hide off a dead cow so that it would make the best shoes for soldiers. All the way between, through every process and at every turn, it watched out for the soldiers' shoes. It looked to the waterproofing of his tent. It evolved baling papers to keep his food sweet and his powder dry as it came over seas. Its workers gave their bodies as feeding grounds for lice in order to find protection against them for the soldier. It sent its rat experts to the trenches in France, to the camps at home and to the storage houses on both sides of the ocean to save the soldier from rat-borne filth and plague. Its plant scouts had found, in far corners of the earth, supplies of the best materials for gas masks. Once, when the

Germans began shooting a new and unknown deadly gas, it happened that some organic chemists in the Department of Agriculture had made that gas synthetically 48 hours before the Germans began the use of it, and means were found, thereby, for saving the soldiers from it. Cotton experts of the department made the substitute for linen wings that kept the allied airplanes in the sky after the Germans had bottled up the bulk of the world's supply of flax.

Back in the early days of the war, when some men were discussing quantity production of various things that had to be made out of thoroughly seasoned wood--such as airplane propellers, gun stocks, parts of the ships that were to carry the Army to France and supply it when it got there--some one inquired, "Do the gentlemen realize that the birds are still building nests in the trees from which those things must be made?" That was true. Under old methods, the far year 1923 would have come and gone before some of the woods required in 1917 could have been sufficiently seasoned. The forestry experts of the Department of Agriculture developed methods under which the seasoning processes that would have required years were completed in as many months. They found substitutes for many woods that could not be had in sufficient quantities. They went to France, regiments strong, and sawed the timber necessary for the expeditionary forces. They did scores of things to make the wood work of war complete and prompt.

Scope of Department's Activities.

The Department of Agriculture looked after the roads over which practically every soldier of the millions marched during his training days and over which his food was hauled to camp. It watched the weather for the flying forces, for the artillery, for the transport systems and for the setting

forth of soldiers upon the high seas. It watched the Army mounts and the Army mules to keep them free of shipping fever and other diseases incident to their arduous duties. It cooperated with every department and with every agency that had to do directly with the prosecution of the war.

But all this amounts to no more than to summarize a summary. It makes the half, or nearly so, of what is told in the accounts of the war activities of the seventeen bureaus, divisions, and offices that make up the department.

The other somewhat more than half has to do with the work of the Department of Agriculture in seeing that enough food was produced to feed not only the armies that this country was to send to France but to make up the food deficits of the allied nations to the end that their armies might remain in the field and effective, that their civilian populations might remain at their lathes and looms, that the war might go on without let-up of pressure anywhere against the horde of super-civilized savages who were stabbing at the heart of Liberty.

The food reserves of the world, in those spring days of 1917, were very low. The whole earth was on short rations. It looked as though, with the coming of another winter, actual hunger and even starvation might be abroad.

About that time there went out to the people of the United States a mighty appeal to save food. Every window, almost, in every city and every town, in every hamlet and at every cross roads, was placarded with posters, declaring that food would win the war, admonishing not to waste it, therefore. Every man, every woman, every child in the United States heard and saw that appeal, and most of them gave heed.

Food Production Problem

But very many of them, likely, never stopped to think that before food can be saved it must be produced. Most of them did not know that a falling off of five per cent in the acreage planted to food crops in the United States would more than offset all the saving that in reason could be done and would leave the world face to face with stark starvation.

If food shortage was to be averted, if a weakening of morale of the arms directed against Germany was to be turned aside, not only must the farmers of the United States plant as many acres to food crops as they had planted in normal years but they must materially increase those acres.

That was the primary and ponderous problem the solution of which the war, on the day that the United States became a party to it, imposed upon the Department of Agriculture and its cooperating agencies.

Now, it is something to ask a man to save food, to eat a little less of certain things. It is a great deal more to ask a farmer greatly to increase his plantings. That means an increase in outlay out of proportion to the increase in acreage. It means, in every case, the risk of loss and, if drought or flood or frost or other disaster come, it may mean ruin--as it did mean to many American farmers in 1917.

For the thing was to be done under many and great difficulties. It was to be done with greatly reduced man power. A million farmers and farm workers went into military service. Other hundreds of thousands were taken away by war industries other than agriculture. Fertilizers were scarce and hardly to be had at all. Many of the materials that go into farm machinery were called for by direct war needs. Nothing that the farmer used was to be had so easily, so cheaply or so abundantly as usual and many things were not

to be had at all. Here, again, was Israel set to make bricks without straw-- and made them. For plantings were increased that year by 35,000,000 acres over the average, and the 1918 plantings were increased by another 5,600,000 acres.

Acreage is a more accurate measure than yields of the war effort of American farmers, but the yield figures tell a striking story. Both crop seasons--1917 and 1918--were unfavorable over large sections, the former especially for wheat and the latter for corn. Notwithstanding, the yield of the leading cereals in each of these years exceeded those of any preceding year in the Nation's history with the single exception of 1915.

The task of securing a more ample supply of meat and dairy products was equally important and was not less successfully carried out.

Peacetime Laws Meet War-Time Needs.

If credit is to be apportioned for that, it goes first to the patriotism of the American farmer and, next, to the fact that the United States, agriculturally considered, was prepared for war. Much of national legislation, enacted for peace purposes, did not fit at all for war needs. Some of it had to be remade; a great deal of it had to be reshaped. But, by some fortune, the national legislation for the promotion of peace-time agriculture hung as fittingly upon the form of war as if made for it. The cooperative agricultural-extension act, providing for the system of county agricultural agents and home demonstration agents; the cotton futures act, establishing definite standards for cotton; the Federal farm loan act, creating a banking system suited to the needs of the farmer; a provision in the Federal reserve act, authorizing national banks to lend money on farm mortgages; the

Federal aid road act, providing for cooperation between the Federal and State Governments in the building of roads--all of these laws, enacted within the four years prior to 1917, served to meet very definite needs in mobilizing the Nation's agricultural resources for war.

When, two days after a state of war was declared to exist, the Secretary of Agriculture held a conference in St. Louis with representatives of agricultural colleges and State departments of agriculture, there was ready a national agricultural system with considerable legal authority for carrying out the plans there made for stimulating agricultural production. It needed some enlargement, of course, and this was forthcoming.

On August 10, 1917, Congress passed the food production act, "to provide further for the national security and defense by stimulating agriculture and facilitating the distribution of agricultural products." The act was to be administered by the Department of Agriculture, and it carried an appropriation of \$11,346,400.

It was to be expended in:

1. The prevention, control and eradication of the diseases and pests of live stock; the enlargement of live-stock production; and the conservation and utilization of meat, poultry, dairy, and other animal products, \$885,000.

2. Procuring, storing, and furnishing seeds for cash at cost to farmers in restricted areas where emergency conditions prevailed, \$2,500,000.

3. The prevention, control, and eradication of insects and plant diseases injurious to agriculture, and the conservation and utilization of plant products, \$441,000.

4. The further development of the Extension Service in cooperation with the agricultural colleges in the States, \$4,348,400.

5. Surveys of the food supply of the United States, gathering and disseminating information concerning farm products, extending and enlarging the market news services, preventing waste of food in storage, in transit, or held for sale, giving advice concerning the market movement or distribution of perishable products, and investigating and certifying to shippers the conditions as to soundness of fruits, vegetables, and other food products received at important central markets, \$2,522,000.

6. The development of the information work of the department, enlarging the facilities for dealing with the farm-labor problem, and extending the work of the Bureaus of Crop Estimates, Chemistry, and Biological Survey, \$650,000.

Out of this money, no new organization had to be formed. The things to be done were things on which the Department of Agriculture was already engaged, into which much of the money regularly appropriated for its maintenance was already going. The emergency money furnished the means, merely, for intensifying some lines of work and broadening the scope of others.

Divide Responsibilities.

The expenditure of additional emergency money was entrusted to the Department of Agriculture. Congress appropriated \$4,000,000 in addition to the \$2,500,000 carried in the food-production act, for the purchase and sale of seed to farmers for cash at cost. The food control act, another piece of war legislation, carried an appropriation of \$10,000,000 to be used in the purchase and sale to farmers of nitrate of soda for fertilizer. The responsibilities of administration were divided between the War Trade Board and the Department of Agriculture, purchases to be made by the former and sale and distribution by the latter.

The food control act, while not administered primarily by the Department of Agriculture, did impose upon it a number of duties, and some of these having to be performed outside of the constituted bureaus, made a

measure of new organization necessary. Under that head came the licensing of the farm-machinery industry, of the ammonia industry, of the fertilizer industry, of stockyards and related industries, the purchase and sale of nitrate of soda to farmers, the purchase and sale of seed to farmers in areas where emergency conditions prevailed. One other new activity entered into the work of the department. An allotment of \$5,000,000 to be administered by the Department of Agriculture was made from the President's special fund to be used as loans to farmers in the drought-stricken regions of the West. This, however, was looked after by permanent employees of the department.

Emergency Funds.

All of these appropriations were for the year ending June 30, 1918. Emergency funds used after that time were provided in an act to enable the Secretary of Agriculture to carry out, during the following year, the purposes of the food production act of 1917. It carried new appropriations totaling \$11,031,863 to be expended in:

1. The enlargement of live-stock production, the conservation and utilization of meat, poultry, dairy and other animal products and the control of live-stock diseases and pests, \$1,058,975.

2. The conservation and utilization of plant products and the control of insects and plant diseases injurious to agriculture, \$811,300.

3. Increasing food production, eliminating waste and promoting conservation of food, educational and demonstrational methods through county, district, and urban agents, and others, \$6,100,000.

4. Gathering information as to the demand, production, supply, distribution and utilization of food, extending and enlarging market news services, preventing waste of food in storage or in transit or held for sale, advice concerning the market movements and distribution of perishable products, and

inspection and certification of perishable agricultural products, \$1,955,608.

5. Aiding various agencies in supplying farm labor, printing and distributing emergency matter, special work in crop estimating and some miscellaneous items, \$1,105,980.

The two revolving fund appropriations for furnishing seed, one for \$2,500,000 and the other for \$4,000,000 were continued, not, however, involving any new funds. The same is true of the \$10,000,000 revolving fund under the food control act for furnishing nitrate to farmers.

This, then, covers the emergency money appropriated to the Department of Agriculture for the performance of its war-time tasks. The regular appropriations were used, in very large part, for work toward winning the war.

The primary purpose of nearly all Government expenditures from April 7, 1917, till November 11, 1918, was to win the war. All money efficaciously spent in that way was, of course, well spent. But much of it got results beyond the end of hostilities--permanent results for the long years of peace that are to follow the winning of the war. That is true of a very large part of what was done by the Department of Agriculture, the story of which is told in the following chapters.

THE OFFICE OF FARM MANAGEMENT.

- - -

Immediately after it was known that the United States was to be involved in the war, the regular work of the Office of Farm Management was directed toward contributing to the needs of the time. One of the constantly grave war problems was the shortage of farm labor. There were times when the situation was critical; when it threatened even to be disastrous. The Office of Farm Management, assisted in some necessary particulars by administrative officers of the department, formed an organization to help the farmers obtain the necessary labor for producing the increased food demanded of them. Special attention was given to a fuller use of farm machinery and the distribution of agricultural labor. This latter work was done in cooperation with the Department of Labor.

A farm help-specialist was placed in every State by the Department of Agriculture. With headquarters at the State agricultural colleges, these specialists cooperated with the colleges and experiment stations, State councils of defense, commissioners of agriculture, State commissioners of labor, and the employment offices of the United States Department of Labor. The State farm-help specialist kept in touch with the county agricultural agents in all the counties of his State, and these, through community farm bureaus and committees, were in direct touch with individual farmers and their needs.

City and Town People Help Harvest Crops.

Farm-help specialists in every State took an active part in bringing to the attention of the district draft boards the necessity of dis-

tinguishing between the degrees of skill of different kinds of farm labor in making a selection for military service. In every State an active campaign was carried on to interest city and town people in crop production to the extent of being willing to devote a part of their time, if necessary, to work of harvesting crops. This campaign was attended with great success in all States, but perhaps the most conspicuous success was met with in Kansas, Oklahoma, Missouri, Indiana, Illinois, Georgia, Pennsylvania, and Oregon.

The number of city residents who went out to work on farms at harvest time, as a result of this campaign, can not be estimated with certainty, but was well beyond 250,000. In most of the States farm bureau employment offices or other local labor offices were established under the direction of the farm-help specialist in order to meet the need of farms for both emergency and permanent labor. These offices were practically always in close connection with the office of the county agent, and were very effective in securing and placing permanent skilled laborers on farms. During the fiscal year ending June 30, 1918, there were placed on farms through the operation of these farm-labor offices, and more especially through the county agents, more than 100,000 regular farm laboreirs.

Several movements for permanent improvement have grown out of this work. The problem of migratory seasonal labor will be studied in more detail in the areas in which it is of greatest importance. In most States the farm-help specialists have found it important to give special attention to intending renters and purchasers of farms. Much attention was given in most of the States to the problem of making labor more contented and, therefore, more permanent on farms.

A beginning has already been made in a concerted effort to bring manufacturing industries directly connected with agricultural production into closer relation with the farming activities involved. For example, one of the large tobacco companies, at the suggestion of the farm-help specialist in Maryland, is considering the proposition of establishing a portion of its manufacturing business in the center of the tobacco section of southern Maryland, in order to give profitable winter employment to the men who, during the summer, work on tobacco farms. This plan, if realized, will not only provide these men with all-year employment, but will make possible more attractive social conditions by means of the community life which they will be able to enjoy. These conditions will obtain more especially during the winter months, when the men give their attention to the manufacturing phase of the tobacco business. This scheme has already been thoroughly tested in Lancaster County, Pa., and has worked out most admirably with reference both to employment requirements and to the prosperity and social development of the community. An effort will be made in every State, where possible, to bring the various industries into closer cooperation with agriculture, in order that beneficial methods of labor exchange may be developed between agriculture and other industries.

Labor-Saving Machinery.

A widespread interest was created in the further study of systems of cropping as related to economy of hand labor and horse labor. Sufficient experience was had with boy labor and women labor to give a fairly accurate estimate of the place and importance of this kind of labor in farm operations. The possibilities of exchange of labor and farm machinery were brought prominently before farmers in every State, with the result that

The first part of the paper discusses the importance of the study and the objectives of the research. It also mentions the scope of the study and the limitations. The second part of the paper discusses the methodology used in the study. It mentions the data sources and the statistical methods used. The third part of the paper discusses the results of the study. It mentions the findings and the conclusions. The fourth part of the paper discusses the implications of the study. It mentions the policy recommendations and the future research. The fifth part of the paper discusses the conclusion of the study. It mentions the overall findings and the final thoughts. The sixth part of the paper discusses the references. It mentions the sources used in the study. The seventh part of the paper discusses the appendix. It mentions the additional information provided. The eighth part of the paper discusses the bibliography. It mentions the list of references. The ninth part of the paper discusses the index. It mentions the list of topics covered. The tenth part of the paper discusses the glossary. It mentions the definitions of the terms used. The eleventh part of the paper discusses the list of figures. It mentions the visual representations of the data. The twelfth part of the paper discusses the list of tables. It mentions the tabular representations of the data. The thirteenth part of the paper discusses the list of equations. It mentions the mathematical formulas used. The fourteenth part of the paper discusses the list of symbols. It mentions the notation used in the study. The fifteenth part of the paper discusses the list of abbreviations. It mentions the shortened forms of the words used. The sixteenth part of the paper discusses the list of acronyms. It mentions the shortened forms of the phrases used. The seventeenth part of the paper discusses the list of initialisms. It mentions the shortened forms of the sentences used. The eighteenth part of the paper discusses the list of contractions. It mentions the shortened forms of the words used. The nineteenth part of the paper discusses the list of idioms. It mentions the common expressions used. The twentieth part of the paper discusses the list of proverbs. It mentions the sayings used. The twenty-first part of the paper discusses the list of metaphors. It mentions the comparisons used. The twenty-second part of the paper discusses the list of similes. It mentions the comparisons used. The twenty-third part of the paper discusses the list of personifications. It mentions the human qualities given to objects. The twenty-fourth part of the paper discusses the list of hyperboles. It mentions the exaggerated statements used. The twenty-fifth part of the paper discusses the list of oxymorons. It mentions the contradictory statements used. The twenty-sixth part of the paper discusses the list of paradoxes. 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systems of exchange of labor were adopted on a much wider plan than ever before. As a single item of such schemes of cooperation may be mentioned the fact that in the three States of Ohio, Indiana, and Illinois many thrashing rings have been formed, each involving from three to twenty farms.

The labor shortage emphasized the need of larger machines and teams than had generally been used, the introduction of such farm machinery as would permit one man to perform the greatest possible amount of work, and the need of acquainting farmers with the advantages of these aids to efficiency. The work previously carried on of collecting and compiling information about farm equipment was accelerated and broadened, with special reference to the needs just mentioned. The newly-gained information was made available in bulletins for free distribution, largely through the aid of actual photographs contrasting labor and time-consuming practices followed in certain sections with improved methods found specially efficient elsewhere. Methods were presented of economizing man labor in general farm practices, but particularly in methods of harvesting and haymaking. Such specially-illustrated publications were in great demand.

Besides the pictorial presentation of labor-saving devices and methods, other publications treated of the care and operation of various farm machines, and the care of the crops which those machines handled. Among these crops were the especially vital ones of wheat, corn, and hay. Concise information was given as to the efficient operation of thrashing machines, thereby aiding in the conservation of grain at thrashing time. The importance of this work is shown by the fact that the Food Administration had men continually in the field in the important grain-producing districts of

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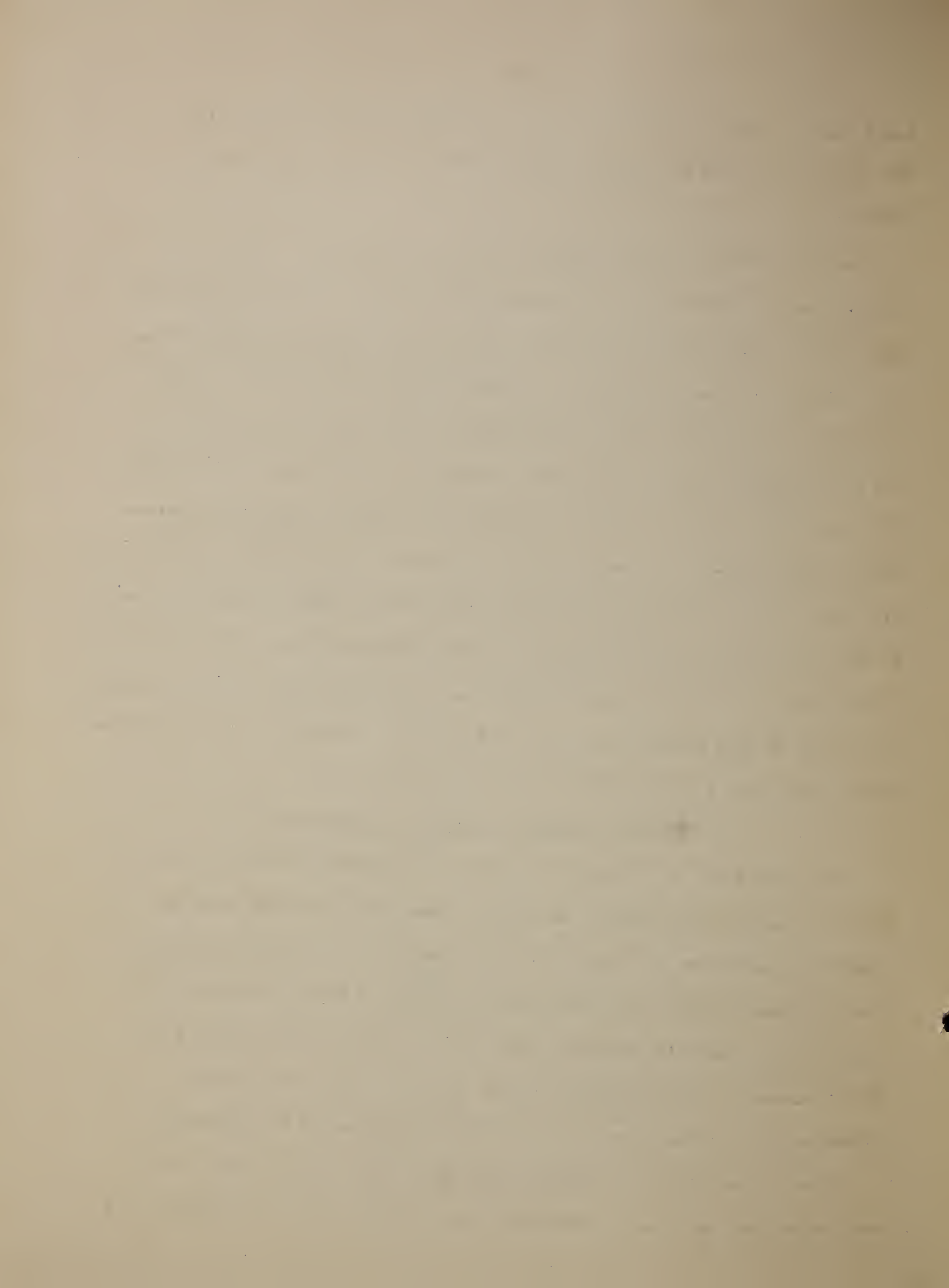
the country, testing grain separators and observing their operation. The material so published has found continued use for instructional purposes.

The gas tractor received during the war exceptional notoriety as a labor saver. Extravagant and questionable claims were made concerning this machine, but it is certain that in very many cases the use of tractors enabled American farmers to prepare, plant, and care for greater acreages of crops with less man labor than would have been possible by the use of horses only. The tractor brought more inquiries than did any other machine or phase of farm equipment. To provide needed information over 10,000 reports were secured from experienced tractor owners, which, with other data already on file, were incorporated into bulletins adapted to the needs of particular regions, special attention being given to the capabilities and limitations of tractors. This information was especially applicable to the Central West and to the Eastern States. Other bulletins of the kind were in preparation at the end of the war.

Licensing Manufacturers of Farm Machinery.

The Secretary of Agriculture placed the licensing of all farm-machinery manufacturers under a separate office, the staff of which included one member of the staff of the Office of Farm Management. The chief purposes of the licensing and regulation of the manufacturers of farm machinery were to conserve steel for war material by eliminating all unnecessary farm machinery, and to maintain fair and equitable prices on all farm equipment under the jurisdiction of the office.

The preparation of a "Geography of the World's Agriculture" had been undertaken some time before the war, and was not a war project, but



it proved a timely publication, appearing just when the attention of all was turned to problems of the world's supply of foods and raw materials of agricultural production. It was in great demand, especially by Government officials who had to deal with supplies or with the stimulation of production.

In planning for increased agricultural production as a war measure, if the area cultivated was to be increased, it was thought safer to increase the area of crops in sections where agricultural practices were established and where production had least risks. One question raised was to what extent areas devoted to hay, forage, and pasture could be utilized in the production of cereals and other crops. It seemed to be particularly important to ascertain the amount and location of agricultural land in farms not utilized by raising crops. The Bureau of the Census, in 1910, collected data showing the amount of pasture land in farms, but this information had not been tabulated. The Census Bureau granted permission to the Office of Farm Management to tabulate these data, which was done, and the results were published in May, 1918, as Department Bulletin 626, Pasture Land in Farms in the United States.

Wheat-Production Survey.

In the spring of 1918 the shortage of the supply of wheat was keenly felt everywhere. The office had in progress for the Atlas of American Agriculture a study of wheat production in the United States and other parts of the world. The figures under consideration were brought up to date as nearly as possible and published in the 1917 Yearbook under the title "The World's Supply of Wheat." The same material was also used in part in the preparation of Circular 90 of the Office of the Secretary,

"The Agricultural Situation for 1918, Wheat." These publications showed the effects of the war on wheat production in other countries, enforced the idea that wheat must be saved for the Allies, and showed clearly the necessity for great efforts to increase the wheat production of the United States.

In the summer of 1918, incidentally to the inquiry which was organized under the direction of Colonel House in New York to collect data preparatory for a peace conference, the Department of Agriculture was asked to cooperate in studying the resources of several countries involved in the war. The Office of Farm Management undertook to collect statistics of the agricultural resources of these countries, to visualize them on maps, and to accompany them by such reports as might be necessary. Work was first begun on Russia, Austria-Hungary, the Balkan countries, and Turkey. Later, the German colonies in Africa were studied intensively. While the collection of this material was in progress, the War and State Departments frequently called upon the Office of Farm Management for information concerning the production of the several countries. The War Department was furnished maps of the production of wheat and rye in Siberia and Russia, and statistics, tables, and notes on the agriculture and agricultural conditions in Russia. The distribution of live stock and the production of crops in Austria-Hungary, the Balkan States, and Asiatic Turkey, and precipitation in Turkey were mapped and submitted to members of the inquiry staff who have become members of the American Commission to Negotiate Peace. The maps showing the distribution of live stock and some crops in the former German-African colonies, and one map each of the international trade in wheat and in wool, have also been submitted.

These maps were intended to visualize facts in such a way as to aid the members of the commission to understand the problems involved, with reference to agriculture, in changing boundaries, establishing new States and changing political control. Their usefulness has been attested by a member of the commission, who, in a letter from Paris, under date of March 12, 1919, says: "The maps are admirably executed and have been of the greatest service in enabling us to determine readily by visual inspection how any proposed frontier would affect the distribution of products, and I can assure you that the results have been of substantial value in helping us to frame our recommendations. I know that the men working in the field of Asiatic Turkey are very enthusiastic over what you have given them."

W E A T H E R B U R E A U

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On the declaration that there existed a state of war by Germany upon the United States, the Weather Bureau, realizing that the science of meteorology was likely to be largely drawn upon in connection with the conduct of military operations, took immediate steps to organize its resources for the part that it would evidently be called upon to play in the conflict. Largely due to the use of airplanes, dirigibles and captive balloons, the highly perfected and powerful artillery and the modern methods of warfare first brought into practice in this war, foreknowledge of existing and expected weather conditions, both in the air and on the surface, were of great consequence. For its work in this connection, the bureau was already largely prepared through its corps of trained weather forecasters and its experience in the taking of meteorological observations both on the surface and in the upper air. It needed only an enlargement of its facilities in order creditably to perform the duties required of it. An early appropriation by Congress provided for much needed extension of its program of aerological observations.

One of the bureau's most efficient forecasters and the official in charge of aerological work of the bureau were commissioned as Majors in the Signal Officers Reserve Corps and, proceeding to the field of operations, were placed in charge respectively of the weather forecasting and military aerological work in France. They were reinforced soon

after by a trained staff of meteorologists and observers taken largely from the ranks of the Weather Bureau. These skilled forecasters and observers, in cooperation with the French and English meteorologists, supplied the Army commanders with every species of meteorological information needed for the most effective work of the infantry, artillery, airplanes, poison gas, etc. The service was based on surface observations over Western Europe and the British Isles and aerological observations made in France by pilot balloons and other special equipment. This was supplemented by nightly telegrams from the central office of the Weather Bureau containing representative weather reports from the eastern districts of the United States, Canada and the Atlantic coast.

Approximately 190⁺ of the trained employees of the Weather Bureau enlisted in the Army and Navy for duty mostly in meteorological units in the United States and France.

Train Soldiers in Meteorological Work

The Weather Bureau assisted in the training of selected enlisted men of the Signal Corps in the taking of weather observations and other meteorological work. The training of the new soldiers in meteorological duties became imperative at once. About 30 were first assigned in groups of three to five at selected large stations. Later, nearly 200 men were cared for at a greater number of stations. In this way, a nucleus of men was quickly trained in essential duties and made familiar with meteorological work and principles.

Later, the Signal Corps established the Meteorological School at College Station, Tex., and selected representatives of the Weather Bureau to take charge of the whole course of instruction.

The bureau established in the United States additional stations for observations in the free air by means of kites, balloons, airplanes, etc., with the object of reporting actual conditions at different elevations for the benefit of aviation and artillery. In portions of this work, close cooperation was maintained with the Signal Corps of the Army, which furnished observations by means of pilot balloons from about twenty military posts.

Special kite flights at night were conducted from time to time at Potomac Park, D. C., and in Texas, for testing searchlights, making experiments in electricity and as an aid to artillerists in detecting moving objects in the air by means of searchlights.

The bureau cooperated with the commanding officers of cantonments, camps, naval stations, etc., by furnishing daily weather forecasts and warnings of unusual and injurious weather conditions.

In cooperation with the Surgeon General's Office, the Weather Bureau prepared meteorological data and made a series of observations required in connection with studies of dietetics, camp sanitation, hygiene, etc.

By furnishing a full set of meteorological instruments and rendering assistance in the training of balloonists, this bureau cooperated with the Signal Corps Balloon School at Omaha, Nebr. One of the experts of the bureau was commissioned a lieutenant colonel and had charge of the school from its inception until near the close of the war.

Cooperate with Aerial Mail Service

Close cooperation was maintained with the aerial mail service of the Post Office Department in furnishing advance information of weather conditions likely to be encountered in the flights. Similar information was furnished to Army officials in connection with long distance airplane and dirigible balloon flights and in the movement of automobile trucks from factories to seaboard.

Meteorological instruments being scarce and difficult to obtain, the Weather Bureau furnished the Army and Navy with instruments and apparatus to equip several meteorological stations at camps and naval bases and undertook the manufacture of meteorographs and other special apparatus urgently needed and that could not be obtained from any other source.

Military officers were frequently furnished with selected and special information needed by them in the conduct of studies and work arising from military needs of various kinds not directly related to any of the foregoing projects.

The Weather Bureau reported all vessels entering and leaving Chesapeake Bay, Hampton Roads, Gulf of Mexico, through the Cuban channel, Columbia River, Straight of Juan de Fuca and other harbors on the Atlantic and Pacific coasts. It also transmitted naval and military business over the Weather Bureau telegraph and cable lines, which were frequently the only wires available, in cooperation with the Coast Guard and Naval Patrol Services.

The following publications in the aid of military meteorological work were issued and distributed by the Weather Bureau:

A Short report of the Climatology of France and Belgium.

Meteorology and Aeronautics.

Mean Values of Free Air Barometric and Vapor Pressures,
Temperatures, and Densities over the United States.

The Turning of Winds with Altitude.

Physics of the Air.

Introductory Meteorology - A Textbook on Meteorology suitable
for use in Instructing Men in the Students Army Training
Corps.

The chief of the Weather Bureau is by law a member of the National Advisory Committee for Aeronautics, the work of which during the war was concerned with military aviation. He is also, by selection, a member of the National Research Council, and as a member of the Military Committee of that body, he was active in many important matters that came before the council.

The Chief Signal Officer of the Army in a recent address before the American Institute of Electrical Engineers, said:

"The success which the meteorological service of the Army has attained would have been wholly impossible had it not been for the intimate and effective cooperation which has been extended to it in all its projects by the United States Weather Bureau."

THE FOREST SERVICE.

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When the United States entered the war the Forest Service lost no time in directing its activities into channels intimately connected with the war effort of the Nation. Its research and field organizations immediately grappled with those war problems nearest at hand. Plans were made for new lines of war work. Without waiting for the call, preparation was made for full cooperation with the military branches of the Government. The employees did their share, through active participation in their respective communities, in all movements tending to the successful termination of the war. The spirit in which this was done was notably exemplified by the work of the women employees who completed the organization of Red Cross units on the day war was declared.

The Forest Service began the development of forest research as one of its earliest activities, some 30 years ago, and during the years while the work gradually gained momentum the thought of preparation for war did not enter into it materially; but the experience of the war period showed that, in research, preparation for peace may be a long step forward in effective preparation for war. A great volume of data were accumulated concerning the stand, distribution, and quality of our forests, concerning both technical and economic problems of production and manufacture, and concerning the mechanical, physical, and chemical properties of wood and how best it can be conditioned and utilized for many purposes. An organization of experts was developed which served as a splendid nucleus for a large expansion and which supplied an invaluable background of knowledge, training, experience,

and outlook.

Use of Wood in Modern Warfare.

The expert knowledge of wood and its problems, gained through years of research, frequently enabled the Forest Service to anticipate problems long ahead of the men responsible for the utilization of results in the military departments. The general purpose of the Service during the war was to use its research organization to help wherever help was needed and to seek out the opportunities without waiting for formal requests. The activities of the Forest Service, first and last, dealt with practically every use of wood in modern warfare--aircraft, both heavier and lighter than air, and for both land and sea, wooden ships, military vehicles, boxes and crates, containers and packing in general, lumber and structural timber, offensive and defensive gas warfare, grain alcohol, acetate of lime, pulp and explosives, hardwood distillation for various purposes, wooden limbs, fiber board, wooden pipe, implement handles, rosin for shrapnel, naval stores products, tannin, nose-plugs for shells, and various pulp products.

In order that the results secured might be known and used, cooperative relationships were established and maintained with practically every one of the numerous Governmental agencies which dealt with the war: in the War Department with the General Staff, the Bureau of Aircraft Production, Ordnance Department, Quartermaster General, Surgeon General, Engineer Corps, and Panama Canal; in the Navy Department with the Bureau of Construction and Repair, Steam Engineering, Yards and Docks, and Supplies and Purchase; with the Shipping Board, Fleet Corporation, Fuel Administration, Director General of Railroads, Advisory Commission of Aeronautics, War Industries Board, War Trade Board, with several of the Allies, and with large numbers of war

manufacturers.

Advice and assistance were rendered members of these organizations on foreign and domestic timber resources, their location, quality, production, and means of increasing production, on manufacturing processes, on the strength properties of wood and its physical and chemical properties, the best substitutes, methods of drying, storing, finishing, and preserving woods, preparation and review of specifications, inspection and training of men, and finally, on various economic questions relating to the wood-producing and wood-using industries. The activities of the organization, in addition, included whatever field and laboratory investigations were necessary to secure basic information.

Artificial Drying of Wood.

For the airplane, the question of artificial drying of wood loomed early as one of first importance. Three-inch green spruce dries in the air in from one to two years. The Allies had practically exhausted the reserve stock of dry Sitka spruce before the United States became a party to the war. Airplane authorities insisted that only air-dried stock was acceptable. The pressure of the Kaiser's armies, however, required some other answer. Forest Service kiln-drying specifications reduced the required period by 12 times, from years to an equal number of months, and the supply of dry spruce lost its sinister place as the controlling factor in airplane construction. These specifications were based on several years' investigative work mainly on other woods and for other purposes, and they have since been checked intensively. Theoretically, properly kiln-dried material should be better than air-dried material for the simple reason that it is possible, in properly regulated kilns, to maintain optimum

conditions throughout the entire period of seasoning, while air-drying permits limited regulation only. If practice sustains theory, the result becomes one of first importance. The advantage in strength and toughness per unit of weight of spruce over its best substitutes is surprisingly small; but, such as it is, Great Britain crossed an ocean and a continent to secure, and the United States organized for its exploitation a body of men which in former wars would have been a large army. The work of the war period demonstrated that properly kiln-dried spruce is, in fact, stronger than that dried in the air even under the best conditions.

Vehicle makers in the United States before the war depended to a large extent upon air-dried material. Specifications for escort wagons called for stock which did not conform to the standard sizes. The accumulated air-dried material on hand was available, therefore, only in small part, and it was necessary to go back to the sawmill to secure what was needed. Oak in large sizes for vehicle manufacture seasons naturally in two or three years. Dry material had to be secured in days. The kiln was again the only solution. The industry, however, did not have kilns, did not know proper methods of drying, and did not have trained operators. Losses from poor kilns or even good kilns inefficiently operated reached from 10 to 50 and even 100 per cent. The Rock Island Arsenal record of December 26 shows what can be done by suitable kilns operated by competent men. Spokes for 56" artillery wheels were dried with a loss of .37 of 1 per cent, spokes for 60" wheels with a loss of .29 of 1 per cent, rims for 56" wheels with a loss of 2 per cent, and rims for 60" wheels with a loss of 1 per cent. Length of time required for drying was even more important-- and the time was reduced to one-twelfth. The type of kiln at the Rock Island

Arsenal was developed at the Forest Products Laboratory, as were also the methods followed. The man who assisted in the initial operation was a Service expert.

The drying of black walnut presented similar problems. Air-drying was the rule before the war. The demand for rifles required the use of kilns, and with the kilns came excessive losses. It is reported that one plant adhering to an imperfect schedule lost 60,000 gunstock blanks, valued at \$1.20 each when green, in a single kiln run. Concerns following closely methods developed by the Forest Service turned out gunstocks with losses not uncommonly less than 1 per cent.

If the war had continued, the supply of naturally seasoned willow for artificial limbs soon would have been exhausted. For air seasoning, a period of three to five years is necessary. Work underway at the Forest Products Laboratory promises to reduce this period to 60 or 70 days without increase in losses.

Wood-Testing Experiments.

A great volume of data on the strength of wood of practically all American species has been built up in the Forest Service during the past two decades. The number of individual tests amounted at the end of the war to no less than 300,000 and covered 130 American species. These tests were of constant and wide application during the war in airplane construction and for practically every other use where a knowledge of the strength of wood was required. For example, they made possible the preparation of tables showing strength values at 15 per cent moisture content which were adopted by both the Army and the Navy as a basis for the design of all wooden parts in aircraft. These data made it possible to select the species

most suitable for airplanes, and they showed that the variation in strength was so great as to render a considerable percentage of even the best woods unsuitable. By a density requirement, it became possible to insure the selection of the strongest stock. By the admission of specified defects in lightly stressed parts, it was possible practically to double the quantity of acceptable stock without sacrificing anything in safety. The latter problem involved little more than the application of data already available and the assignment of one man for a period of about three months. Many thousand men in the woods and at the mills would have been needed to produce the same quantity of spruce.

One country lost many planes in flight because spiral-grained spruce was used in construction. Forest Service tests prevented similar losses for the United States by showing where the line between straight and spiral-grained material could be drawn safely. Little was known at the beginning of the war on the strength of plywood as a material. The need for this information was supplied very rapidly by an extensive series of tests which became the basis of all of the present plywood specifications and of plywood strength factors used in airplane design by both the Army and the Navy. In addition, the tests made it possible to adopt with safety the utilization of more species than had originally been thought suitable and thus prevented the supply of plywood from becoming, as it might easily have become, a factor controlling airplane production.

Further applications of strength data were found in the design of wing beams and wing ribs. Laminated wing beams, for example, offer the opportunity to utilize a much larger per cent of the spruce cut, a percentage far too low at the best. Special supplemental tests developed

types of laminated and spliced wing beams as strong as the solid wing beam of the first planes, and the types developed have been adopted by the Army and Navy. As an example of the special supplemental tests on wing ribs may be cited those for an American combat plane produced in large numbers. The weight of the standard rib was reduced by one-third and the strength per unit of weight was increased three times. The wing so developed was adopted and similar designs were developed for six other Army and Navy planes.

Strength tests have a further application in ship timber, and this and other information served as a basis for a comprehensive series of recommendations to the American Bureau of Shipping and the Fleet Corporation on the specifications to be followed in the selection of timber. Special tests of boxes were needed to supplement the strength tests of wood as a material. Fortunately, methods and special testing equipment had been developed before the war. In some specifications which involved the construction of hundreds of thousands of boxes, the number of woods permitted was increased from 1 to 30. It became possible to use the woods at hand and to make full use of the facilities of box-making plants wherever they might be. In addition, nailing, strapping, and construction in general were standardized and adapted to the very severe war requirements in overseas shipments. Redesigns saved enormous quantities of cargo space. Large sums were saved in initial costs. Losses since July 1, 1918, at ports of arrival in France are reported officially to be only 15 per cent of those before July 1.

Timber Supply and Production.

Another general class of problems of first importance dealt with timber supplies and production. A general survey was made of the timber resources of the United States in order to make sure that supplies of woods should not be dangerously reduced before provision could be made for substitutes. The best data available were maintained on requirements as compared with current production, and similar data were secured concerning the forest resources of other countries. For special woods and for special purposes, much more intensive studies were required. It was not sufficient to be able to furnish data on the properties, conditioning, and uses of wood in airplanes. If it became necessary to select substitutes for spruce, knowledge as to supplies, quality, current production, and the extent to which production could be increased was necessary on those woods which, from the standpoint of properties alone, seemed to meet requirements. The program on airplane woods included field studies of the eastern spruce, practically equivalent to the Sitka spruce of the Northwest, and such other possible substitutes as Port Orford cedar, Douglas fir, eastern white pine, Norway pine, western white pine, yellow poplar, western hemlock, silver, noble, white, and lowland fir, and even sugar pine, cypress, redwood, and western yellow pine. The work on eastern spruce was being followed up intensively by the Navy, but work on many of the other species was far in advance of immediate requirements.

Black walnut is the accepted gunstock wood. It had been cut heavily for years. Production was not meeting requirements. It became necessary, therefore, in cooperation with the States and other forestry agencies and the Boy Scouts, to make a field survey throughout practically the entire

range of this tree. New sources of supply were found, new producers were interested, and processes of manufacture inspected and supervised to insure the most efficient cutting of the material; for it must be remembered that the black walnut was almost equally needed for airplane propellers. Fortunately, the requirements for these two purposes could be reconciled. Production was more than doubled. The supply of black walnut was no longer a critical problem when the armistice was signed. Two or three years more of war might, however, have required the use of substitutes.

Demand for tonnage in the transportation of food, munitions and armies left none for the imports of tannin on which the United States had depended. It became necessary to increase domestic production, and, as a basis for this, a field survey made by the Forest Service indicated necessary lines of action for individual plants throughout practically the entire region of tannin production.

Various economic questions relating to lumber, pulp, and other important forest and wood-using industries were studied in order to keep in touch with developments in the industries, to anticipate difficulties, and to provide Government organizations with the information which they might need for administrative action. Badly needed materials, such as a satisfactory coating for airplane propellers and waterproof glues primarily for plywood, were developed, as were also methods of inspection and certification for glues in general. Material assistance was given in the technical training of men, for which always the demand far exceeded the supply.

Protection of Tunnels and Bridges.

One of the first steps on the part of the Forest Service field officers on the entrance of the United States into the war was to assume,

in part, the protection of the means of communication useful for military purposes in the less accessible portions of the country. The forest rangers were well fitted for this work. They added to their regular duties the protection of tunnels and bridges of the larger railroads. Particular attention was given also to the protection of the water supplies of the various municipalities that had the major portion of their water-supply system in the more remote parts of the mountains.

The wide distribution of the field men through the smaller communities made them peculiarly useful in assisting the various campaigns of patriotic but nonmilitary character, which played so important a part in the general scheme.

The field men assisted in the extension of the food and fuel organizations and, in many instances, served actively as members of the local, county and even State organizations. The close relations existing between the utilization of the agricultural, grazing, and timber resources and the interests of the communities made it desirable that the Forest officers be actively associated with these efforts. The results obtained in this respect came up fully to expectations and brought full compensation to the men in the satisfaction of knowing that their extra efforts were successful.

Not the least important was the affiliation of many of the men with the Four Minute Men organization. The Forest officers thus affiliated were able, in connection with their regular field trips, to carry the messages of the Four Minute Men into isolated communities, which would not have been done otherwise.

In the early period of the war, when the War College had no appropriation for a corps of translators and the urgent need existed for information from foreign sources, several members of the Washington Office of the Forest Service conversant with various languages organized a volunteer corps of translators. Within the range of this corps came Russian, French, German, Italian, Spanish, and Scandinavian languages. The papers translated covered many subjects on which information gathered from actual war experience by other nations was urgently needed for the training and equipment of the Army. The subjects ranged all the way from artillery practice to the training of skirmishers and from aiming bombs from airplanes to the training of dogs for war purposes. In connection with the organization of the 10th Engineers (Forestry) a vocabulary of French and English forestry and lumber terms was compiled, mimeographed, and bound in handy form.

Because of the particular fitness and previous training of some members of the Washington office in Russian matters, much information was given to the State Department, the Military Intelligence, and particularly to the inquiry on the Russian situation, especially during the early part of the war.

Forest Specialists in Military Service.

The varied character of the field work of the Forest Service is such that a large number of the men are specialists in lines for which there was considerable need in the military service. It was with increased difficulty, therefore, that men were held to their regular duties with the Forest Service when calls to active military service were made for men of such special qualifications.

To meet the situation thus created, every effort was made to reduce the work of the Forest Service to the lowest possible point where there would be no interference with the maintenance of a skeleton organization able to carry on the essential work without danger to the National Forests. By such reduction it was possible to relieve for military duty a large number of specially qualified men. Most of the men released entered the engineering branches and the largest number were assigned to the 10th and 20th Engineers.

Immediately after this country entered the war, a call was made on the Forest Service by the War Department for assistance in the organization of engineering troops specially qualified for operations in the woods. The absolute necessity for this had been realized by the Allies and it was at their suggestion that such troops were recruited.

The services of the Forester were tendered to the War Department and accepted. In order to get the intimate information absolutely necessary, he at once proceeded to France and made a study of conditions. As a result, a special staff organization was perfected in France. It was drawn to a considerable extent from the higher officers of the Forest Service and included an Assistant Forester and a District Forester. This staff formulated the plan of work in France and made the necessary preparations in advance of the arrival of the forestry troops from this country.

The entire personnel of the Forest Service played a part in recruiting the forestry regiment which was designated the 10th Engineers (Forestry). The splendid record of this body of men has been a great satisfaction and the success attained is without doubt due to the careful manner in which the personnel for the regiment was selected.

The officers and men were chosen after very careful consideration of their qualifications for work in the woods. Particular attention was given to their character and standing. It was only after the closest scrutiny that the men were accepted for this specialized service.

This regiment and the 20th Engineers, organized later, had assigned to them the task of furnishing the forces in France with the necessary timber supplies from the French forests. They supplied building material for the various docks, roads, and supply depots that were built to handle the men and supplies shipped into France, and furnished considerable material needed by the combatant forces at the front.

New Ranges Opened for Stock Grazing.

The imperative need of the country for the greatest possible production of meats, hides, and wool was partially met by the Forest Service by making provision for carrying increased numbers of stock on the ranges. This was accomplished by opening new ranges hitherto not used for grazing purposes and by the placing of larger numbers of stock on ranges already under use. The latter placed a very heavy tax on the carrying capacity of the range and, without the most skillful handling of the situation by the Forest Service, it might have resulted in such severe damage to the ranges as to require a long period for recovery. The most careful consideration was given to this matter by the grazing experts and there is every feeling of confidence that no permanent damage resulted. These efforts permitted the increase in the number of animals allowed to graze on the National Forests by about 1,063,000 head.

Considerable cooperation was given the War Department by field officers, particularly in the Western States, in which the National Forests

are situated, in collecting and compiling all kinds of data needed for military maps. Special attention was given to information relating to the means of communication. Notation was made of available food supplies, water resources, areas adaptable for the growing of crops, and regions needing special protection.

The facilities of the drafting room and photographic laboratory were very heavily drawn on by many of the bureaus of the War Department not adequately equipped to make maps or reproduce existing maps in quantities to meet the demands.

Train Foresters in France.

Two representatives of the Forest Service were appointed by the President as members of the National Research Council. Advice has been given on a number of forest problems and connections established between investigative work in forest, chemical, physical, and similar problems. Plans were prepared for reorganizing the training of forestry for war purposes, for the use of cut-over land, and for professional and vocational training of foresters in France.

Every effort was made by the Forest Service to stimulate in the Northwest the production of lumber from Sitka spruce for the Bureau of Aircraft Production. The spruce occurs on but a few forests. It is found on the Olympic National Forest in Washington, the Suislaw Forest in Oregon, and the Tongass in Alaska. Sales aggregating about 40,000,000 board feet were made.

Use of Wood for Fuel

Soon after the entrance of the United States into the War it became apparent that there was to be a serious coal shortage, especially of

domestic coal. The Forest Service felt that a campaign to stimulate the production and use of wood for fuel would be a patriotic move, and would at the same time fit into the regular forestry work since it would give an opportunity to market a great deal of inferior wood. Circular 79, Office of the Secretary, "Emergency Fuel from the Farm Woodland," was issued and was followed by other publications. A wood fuel program was presented to the Fuel Administration by the Forest Service, and was partially adopted. Under this plan the Forest Service supplied the Fuel Administration with a number of foresters to organize the wood campaign in the various States.

The plan followed was to get the Fuel Administrator for a State to appoint a State wood fuel committee. On this committee the State Forester, professor of forestry at the agricultural college, and the director of the extension service were usually members. This committee, in some cases, organized similar county committees in which the county agent or a representative of the farm bureau acted as chairman. By a campaign of publicity through posters, the press, and local meetings, much publicity was given to the need of wood. Wood-cutting bees and cut-a-cord clubs to popularize the cutting of wood among people with idle time, were organized in certain sections. In some regions municipal woodyards or war wood-fuel companies were formed to guarantee a fair price for the producers and an adequate supply for consumers.

It is estimated that as a result of this work, the consumption of wood was increased at least 10 per cent, which means a saving of about 7,500,000 tons of coal, or about 7 per cent of the coal used domestically.

In the latter part of the war a considerable body of statistics and other information on forest and water resources of the world was gathered by the Forest Service and codified for the use of peace delegates.

THE BUREAU OF ANIMAL INDUSTRY.

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In two principal ways the Bureau of Animal Industry contributed to the power of the United States in its war with Germany. Trained and qualified members of the bureau served directly with the various military branches of the Government. Most of these men were veterinarians and skilled inspectors, or they had other technical knowledge which made their services especially valuable.

A larger though less dramatic contribution was a readjustment of the bureau's organization and the introduction of "high gears" in activities where speedy results were essential to proper support of the battle lines.

Meat Inspection Division.

One of the first branches of the bureau affected directly by the entry of the United States into the war was the Meat Inspection Division. Shortly after a state of war was declared, the War Department requested the Federal Meat Inspection Service to reinspect the meat and meat food products furnished the various cantonments, forts, camps and other places, to protect the health of the troops, by insuring that the meats originated at establishments operating under Federal meat inspection, that the supply accepted by the Army had not deteriorated after leaving the packing plants, and that it otherwise conformed to the Army specifications.

At the time of actual issue to the troops another reinspection was made by bureau inspectors to insure that the meats had not deteriorated since they were received at the camp, fort, or similar place. Sixty-seven inspectors were assigned to the work. The quantity of meat and meat-food

products inspected was 342,626,972 pounds, of which 4,335,035 pounds was rejected.

Similar arrangements were made with the Navy Department and consisted in inspecting all meat and meat-food products at the time of preparation in official establishments to see that they were prepared in accordance with Navy specifications. A reinspection to see that no meats which had deteriorated while in storage or transit were accepted was made at navy yards and other points where Navy vessels were supplied with food. Additional inspectors were detailed in the establishments operating under Federal meat inspection. This service inspected 194,453,654 pounds of meat and meat-food products for the Navy, of which 5,453,966 pounds was rejected. By special request of the Navy Department, representatives of the Meat Inspection Division also inspected poultry, fish, oysters, clams, dairy products, and other food commodities.

Protecting Meat Supply from Contamination.

To protect the military meat supply from possible contamination by unscrupulous persons, special and continuous supervision was maintained and chemical analyses made of the finished products before delivery.

Shortly after the declaration of war, the service inaugurated a food-conservation movement in meat-packing establishments with the view of eliminating food wastes, avoiding the use of edible products for inedible purposes, and adopting such measures as would prevent spoilage of meat from avoidable causes by discovering the causes and bringing them to the attention of the proper officials of the establishment, which resulted in a very substantial saving of food.

The orders of the United States Food Administration, the War Trade Board, and the War Industries Board applicable to the meat industry were given special attention with a view of making them effective. A great mass of statistics and other information requested by other Government organizations was furnished.

For the first time in the history of the bureau, women were appointed to assist in meat-inspection work at the packing houses because men were not available. The plan proved so successful that a civil service register of women eligible for appointment in such positions has been established.

Stimulating Food Production.

The Bureau of Animal Industry has always been largely a field organization, with its personnel widely distributed in the producing areas or stationed at live-stock market centers. Such an organization naturally adapted itself quickly to the critical need for propaganda in food production.

Active propaganda in the production of pork, poultry, beef, mutton and wool was carried on by the Animal Husbandry Division in cooperation with the States Relations Service and agricultural colleges. The Division cooperated also with the War Department in providing for the breeding of mares purchased in connection with war activities.

The appropriation for the emergency work became available so late that little time was left in which to organize the campaign to increase 1918 pork production, of which 15 per cent increase over 1917 was needed. It was possible, however, to make a rapid survey in cooperation with the Bureau of Crop Estimates to determine the probable surplus of corn from the 1917 crop and to allot on that basis the

increase in pork production warranted by the increase in the 1917 corn crop. The increase recommended varied from 5 per cent in States like Georgia and West Virginia to 25 per cent in Iowa and Kansas, and 50 per cent in Missouri. An appeal was made direct to the agricultural colleges of the States in which increases were requested, especially in the Corn Belt, for the loan of men to be used in the campaign. In addition, considerable numbers of men were added to the pig-club force and placed mainly in the Southern States. Naturally the greatest increase was expected in the Corn Belt, and in that section the co-operating extension divisions used two systems: one was to organize strong speaking campaigns, the speakers being practical pork producers and successful farmers. The campaign was put on intensively just before the fall breeding season began in 1917. The other system was to conduct an extensive campaign through the medium of country bankers and the country press as well as county agents. Frequent conferences and actual personal touch with farmers were important parts of this system.

In the spring of 1918 the breeding propaganda was followed by a campaign to save pigs at farrowing time. As a result of these efforts, the estimated total number of hogs on hand January 1, 1918, was 70,978,000 compared with 67,503,000 on January 1, 1917, an increase of 5.1 per cent. The estimated number of hogs on hand January 1, 1919, was 75,587,000, an increase of 6.5 per cent over January 1, 1918, and an increase of nearly 12 per cent over January 1, 1917. In addition to the actual numerical increase, farmers fed hogs for more weight in 1918 and added materially to the pork output in this way. The average weight of hogs on the Chicago market in 1918 was 234 pounds

as against 213 pounds in 1917, an increase of practically 10 per cent.

Pig-club enrollment increased greatly during 1918, approximately 75,000 boys and girls participating in the work during the year.

Emergency Poultry Campaign

Since actual work to increase poultry production did not need to begin until the early spring of 1918, it was possible to organize this project more thoroughly than the emergency pork-production project. In starting and conducting the emergency poultry campaign, the following facts were foremost in mind:

1. That the primary purpose was to secure an increased production of both poultry and eggs largely for domestic consumption in order to release red meat for export.
2. That this increased production was needed at the earliest possible time.
3. That an increase could be best realized from the farm flocks and from that section of the country where poultry keeping is most extensively carried on.

The country was divided into four districts and district agents stationed at Chicago, Kansas City, Oklahoma City and Los Angeles, to supervise the territory assigned.

The poultry-production program had nine features as follows:

1. Keep better poultry.
2. Select vigorous breeders.
3. Hatch the chicks early.
4. Preserve eggs for home use.
5. Produce infertile eggs for market.
6. Cull the flocks.
7. Keep a back-yard flock.
8. Grow your own poultry feed.
9. Eat more poultry and eggs.

The slogan of the campaign was "100 hens on every farm and 100 eggs from every hen."

Supplementing the organization of paid employees, the division

obtained a great deal of assistance from voluntary helpers, most of them members of the American Poultry Association. These local leaders were selected to cooperate with the State poultry specialist and the county agent to relieve the latter officer of details of the poultry campaign. In a number of instances the same purpose was met by appointing a poultry representative on the local farm-bureau committees. At present there are over 5,000 such local leaders. The service of these people has resulted in enormously multiplying the effectiveness of the poultry specialists in the extension organization.

The campaign for preserving eggs for home use has been unusually successful. Fully twice as many eggs were put down in waterglass for home use during 1918 as ever before. This work extended over all the country, both in cities and in the rural districts.

Back-Yard Poultry Keeping

Back-yard poultry keeping received a big impetus. In February 1919, the "Hatch Early" campaign which was started in a small way two years before, was in full progress from one end of the country to the other. Poultry papers emphasized in every issue the importance of hatching early in order to have fall-laying pullets.

The most outstanding feature in the emergency work in beef production has been the movement of cattle out of the drought-stricken regions of Texas and other Southwestern States and the Corn Belt. The continuation of the drought and the availability of funds made possible a repetition in the summer of 1918 of the work done in 1917. Altogether about 300,000 head of cattle were moved out of Texas as a result of this effort.

Emergency work in sheep and wool production was largely confined to the addition of specialists to the extension divisions of the agricultural colleges to give expert advice in farm-sheep raising. A cooperative survey with the Forest Service indicated the location, price and character of 300,000 ewes being offered for sale in Western States. This information was furnished to extension divisions in States where sheep were wanted and resulted in the conservation and use of a sufficient number of ewes to establish a large number of farm flocks.

There has been a material increase in the number of sheep in the country during each of the last two years. Prior to that time, a steady decline had been recorded for many years. In addition, the number marketed in 1918 was much larger than in 1917. The 1918 wool clip exceeded that of 1917 by 12,000,000 pounds. A large number of new farm flocks has been established and the industry has extended into some sections of the South which are naturally adapted to sheep raising.

Work of Dairy Division

In the field of dairying, the Bureau's war work has been unusually extensive. The Dairy Division fortunately had a flexible organization which solved many technical problems while it was conducting inspections, stimulating dairy production, and encouraging food substitution and conservation.

Through inspectors stationed at various creameries, the division supervised for the Navy Department the manufacture and packing of 3,100,763 pounds of butter in the summer of 1917, and 9,326,204 pounds during 1918. All of this butter was made from unripened, pasteurized sweet cream which investigations of the Dairy Division had shown keeps better than any other kind of butter. When storage butter was

commandeered for Government use in the fall of 1918, the division furnished two men who, as representatives of the Navy Department, spent two months inspecting and storing butter in cold storage warehouses at Boston and Chicago.

Through efforts of the Dairy Division, large savings in creamery by-products have been brought about. Results in this field were so striking that the force of ten field men employed in the summer of 1917 was doubled in 1918. Through efforts of these men, the operators of 124 creameries and milk plants, where skim milk or buttermilk was either wasted or not used to best advantage, were induced to convert them into human food. In that way 26 million pounds of skim milk and buttermilk has been utilized in making cottage cheese and condensed skim milk. In addition assistance was given in the quality of cottage cheese at 154 plants already making that product.

War activities in the market-milk work included cooperation with officials of the United States Public Health Service. Representatives of the Dairy Division spent a great deal of time in the extra-cantonment zones to improve the sanitary condition of milk and dairy products and to make available a larger supply of these products for use by the troops.

Pasteurizing Facilities Enlarged

Through Dairy Division efforts, pasteurizing facilities were enlarged, technique improved and, when occasion demanded, new pasteurizing plants were built. The bureau has learned of no outbreaks of disease traceable to the milk supply of any of the camps. Frequent visits were made to the Naval Academy Dairy at Gambrills, Maryland, to maintain the high quality of milk for the midshipmen. The market milk section of the Dairy Division carried on two special campaigns to prevent losses in the Nation's general supply of milk. The first showed the importance of

sterilizing milk utensils. This campaign was conducted through 180 health officers in different parts of the country who demonstrated in their communities the sterilizing outfits sent them by the division.

The second campaign was undertaken to prevent losses of milk through spoilage, by encouraging the storage of natural ice, and the use of ice in cooling milk.

The research laboratories of the Dairy Division successfully attacked many interesting and important war problems. For instance, airplane construction called for a special waterproof glue made from milk casein, most of which had been imported. When the Shipping Board shut off the importation of casein, the Dairy Division was asked to supervise the manufacture in this country of casein suitable for waterproof glue. A new procedure of manufacture suitable to American factory methods based on previous work in the laboratories was developed and put in operation on a large scale within two months. This casein proved to be of much higher grade than any previously manufactured on a large scale. There was no serious increase in cost. In cooperation with the Forest Products Laboratory, which was studying the casein glue for the Bureau of Aircraft Production, the laboratories performed extensive work on the analysis of commercial casein and on methods of inspection.

Experiments were conducted to determine whether cotton waste, known as mill sweepings, could be freed from mineral oil and other impurities by biological means so that the cotton could be made into gun cotton. A method for treatment by bacteria was worked out which results in a relatively pure cotton. The division cooperated in research investigations of the Army Medical School and the Sanitary and Medical Corps.

Sugar Substitutes Found

To aid in the conservation of sugar, Dairy Division experts studied possible substitutes for use in ice-cream making and found a number which could replace satisfactorily as much as 50 per cent of cane sugar.

Preliminary study has been made of reconstructed milk in cooperation with the manufacturers of emulsers and milk powder, and the product displayed to officers of the War Department. A considerable quantity of reconstructed milk and about 250 gallons of ice cream were supplied to the United States Public Health Influenza Hospital.

An expected scarcity in concentrated feeds led the Dairy Division to inaugurate a campaign of information to stimulate production of home-grown feeds for dairy herds. It emphasized particularly the construction of silos and the growing of legumes.

Anticipating also a curtailment in the number of dairy cattle in certain sections where feed prices tended to rise, the Dairy Division perfected a plan for the redistribution of all good cattle in such sections to territories where dairy animals were in demand. Several thousand head of dairy cattle were distributed throughout the sections in the South and West, where dairying was new.

The Dairy Division has given assistance and advice relative to dairy matters to the Food Administration, War Industries Board, War Trade Board, Shipping Board, and Capitol Issues Committee.

In addition to its efforts in stimulating production of animal products, the bureau sought greatly to reduce losses from disease, parasites and similar causes. This field of service extended not only to food supplies but included Army horses and mules, the wool supply, and other factors bearing on the proper maintenance of the Nation's armed forces.

Forty-seven bureau employees in the Field Inspection Divisions were assigned to full time service with the War Department in connection with the prevention and control of contagious diseases of animals. In addition, employees at regular bureau stations were charged with conducting similar work in cooperation with the War Department.

Campaign Against Animal Diseases

An intensive campaign to improve the sanitary condition of all premises where Army horses and mules were handled was carried on. Diseases of horses and mules, especially influenza, were reduced to a minimum. A very marked improvement in the sanitary condition of stables, pens, stockyards and other premises throughout the country was effected. Special efforts were made to prevent and control contagious diseases, particularly anthrax among meat-producing animals, and vigorous measures were taken to arrest all local outbreaks. Excellent results were achieved, especially in the western Gulf States, where heavy losses from anthrax occurred during 1917. During 1918 the losses from that cause were comparatively inconsiderable.

Every measure consistent with safety was taken to encourage the traffic in stocker and feeder hogs, thus assisting very materially in stimulating pork production. That the trade increased tremendously during the period of the war, is shown by records of swine immunized under supervision. During the fiscal year ended June 30, 1918, 254,731 swine were immunized under bureau supervision while during only the first half of the fiscal year 1919 a total of 325,325 hogs were immunized.

Additional efforts were made to prevent and control the common diseases of sheep, especially scabies. During the fiscal year 1918,

5,585,543 dippings of sheep in the field were supervised while in the first 6 months of the fiscal year 1919, 7,332,043 dippings were supervised. This work is an important factor in the production of mutton and wool.

An important direct war activity of the Biochemic Division of the bureau has been the production of mallein for the United States Army, to test horses for glanders. Practically the entire supply of mallein for the Army from the beginning of the war was furnished by that division.

The bureau increased its efforts to eradicate the southern cattle tick. The regular tick-eradication fund was supplemented by the expenditure since April 6, 1917, of approximately \$200,000 from the appropriation "Stimulating Agriculture and Facilitating Live Stock Production." The allotment from the stimulating fund made it possible to extend cooperation to State authorities in tick-eradication over a much larger area than otherwise could have been reached. On December 1, 1918, there was released from Federal quarantine 79,217 square miles as compared with 65,520 square miles released on December 1, 1917. This was accomplished in spite of the fact that many of the veterinary inspectors of the bureau entered military service for duty in the veterinary reserve corps, and the States and counties also experienced difficulty in providing capable men for duty as local inspectors.

Cattle Tick Eradication

The eradication of the cattle tick results in stimulating the cattle industry and in general improvement of agricultural conditions over the area affected. Such development of resources strengthened the food firing line during the war and better prepared this country for

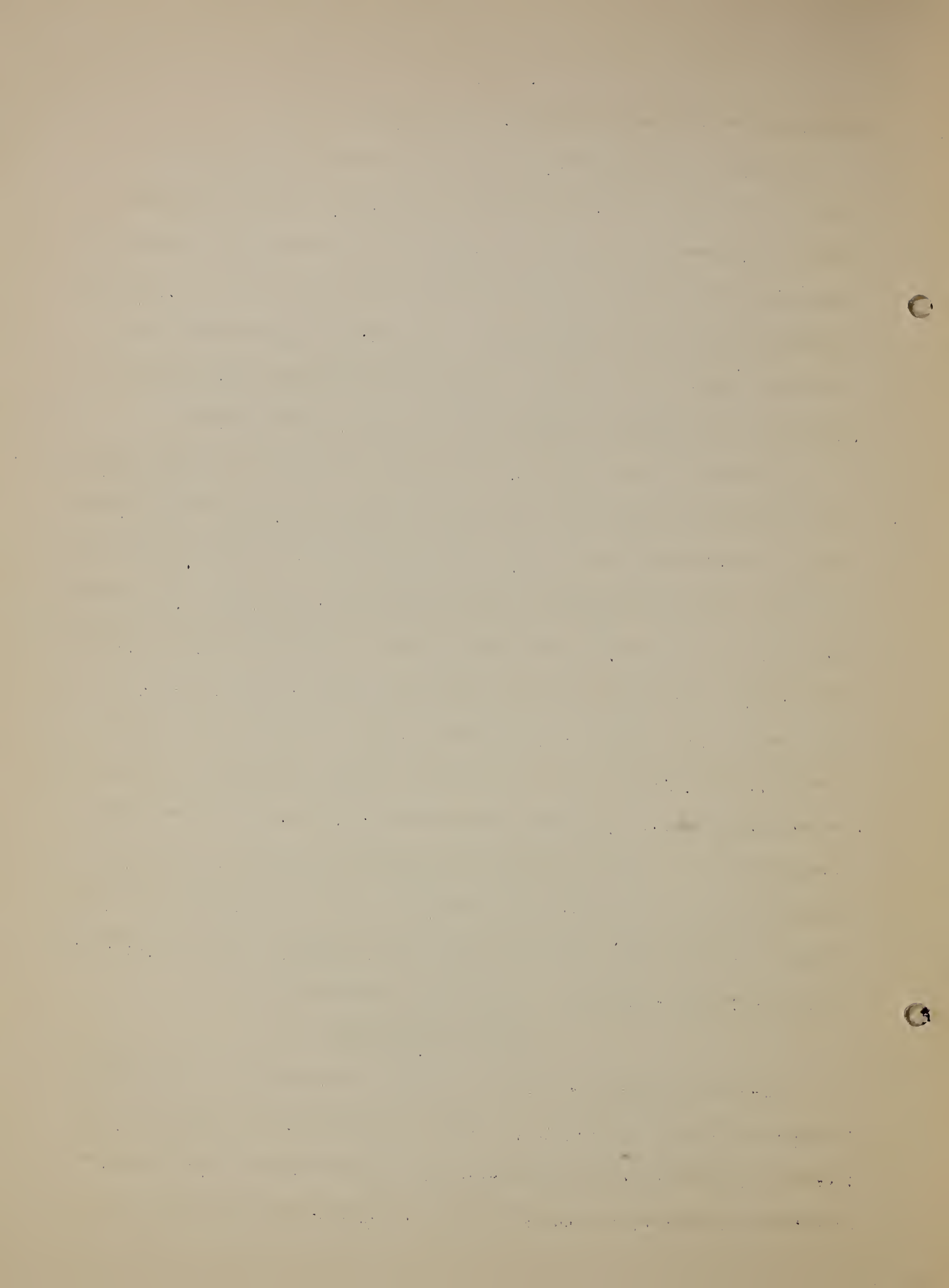
meeting knotty economic problems of the future.

Through its investigations of animal parasites, including the cattle tick, the Zoological Division of the bureau was an important source of information on matters relating to the removal of obstacles to economical live-stock production and the handling of foods. In response to requests from the War Department, the division supplied information concerning parasites, examined and determined specimens, and supplied material to be used for instruction in the Army Medical School.

A series of investigations on trichinae has been completed. These are parasites of common occurrence among hogs and transmissible to human beings in improperly cooked pork, sometimes with fatal results. The work has shown that the vitality of the parasites can be destroyed by certain refrigeration processes. The degree of heat necessary to destroy them in the cooking of pork also has been determined, and curing methods have been devised that insure the destruction of the parasites in products prepared customarily to be eaten without cooking. Through the control of meat-packing processes, rendered possible by results of these investigations, consumers of certain pork products prepared in establishments operating under Federal inspection have been safeguarded from the danger of trichinosis. No cases have been reported in the Army, traceable to such products prepared in inspected establishments.

Hog-Cholera Control

A bureau activity, noteworthy because of increased hog production during the war, is the work in controlling hog cholera. Hogs not only increased in numbers but higher prices and the tendency toward greater weight made important the suppression of serious swine diseases, of



which cholera is the foremost.

The bureau expanded its activities in hog-cholera control and increased its force of veterinarians for that work from 85, the normal number, to about 160. With the aid of emergency funds, the work has been extended, since April 6, 1917, to 14 States which prior to that date had not received the benefit of this class of assistance. In a number of other States, where projects of this character were already effective, activities were increased to cover the entire area of the States instead of being confined to certain parts of them. The rate of swine mortality from cholera for the last fiscal year -- 42 per 1,000 -- is the lowest on record.

An important result of war activities in the control of hog cholera has been a realization that previous efforts were not sufficient to cope properly with conditions as they existed.

The effectiveness of hog cholera control has depended in a major degree on the adequate production of serum and virus used in immunizing swine. Even in the face of war conditions, production of veterinary biological products, especially antihog-cholera serum, increased decidedly in volume. The quality, also, was improved. Firms licensed by the department will prepare, during the current year, larger volumes of biologics than ever before. Notwithstanding great difficulty in maintaining an adequate force of inspectors, the office of Virus-Serum Control has given special attention to supervision of biological products from abroad. One of the most important lines of work was to see that the virus of infectious diseases, such as foot-and-mouth disease, was not introduced into this country either intentionally or by accident

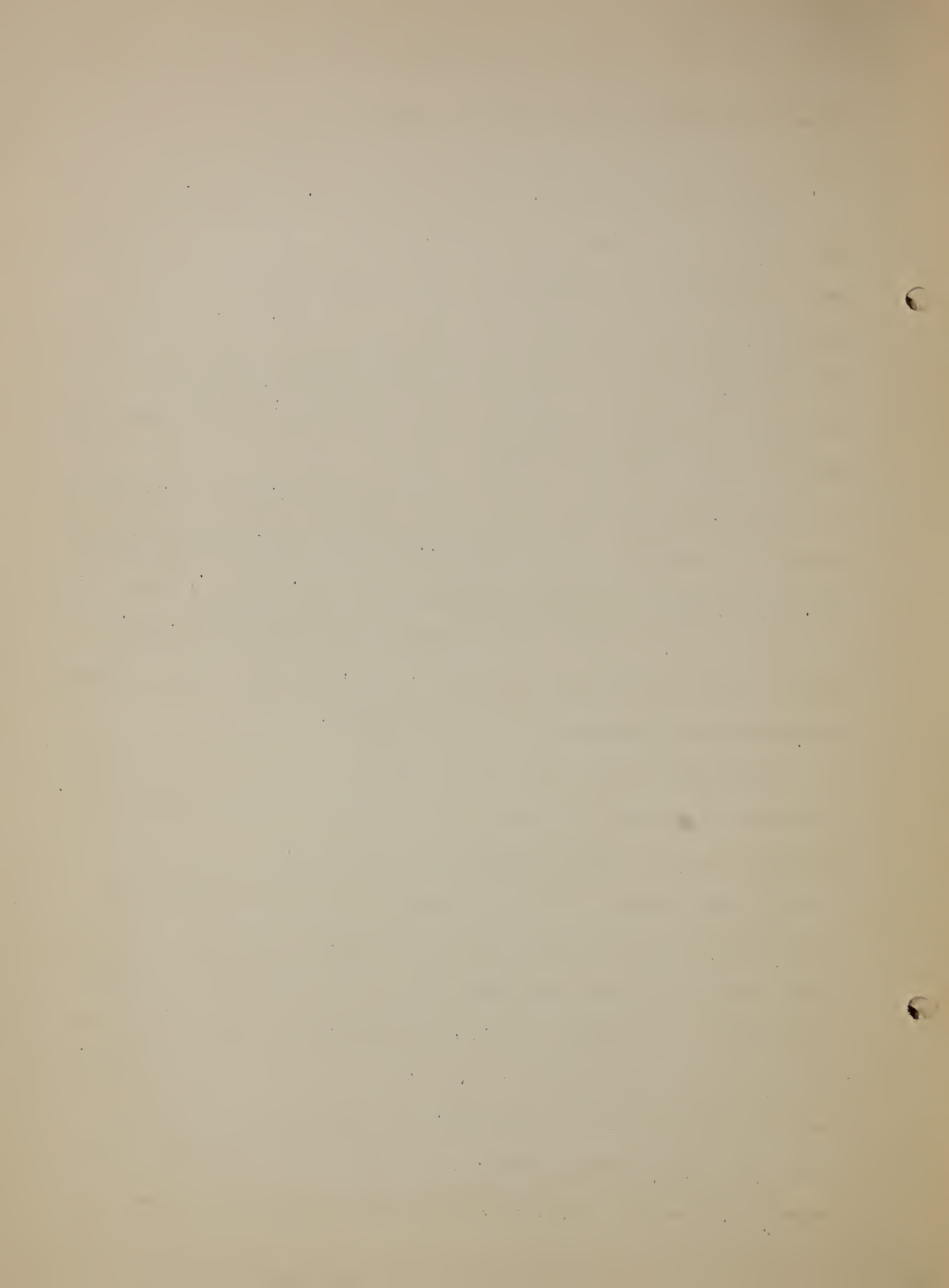
through contamination of biological products.

Controlling Tuberculosis in Live Stock

Another important field of disease eradication contributing to the Nation's food resources has been the work of controlling tuberculosis in live stock. The Tuberculosis Eradication Division was established in May, 1917, and since that time has been ready to cooperate in war activities. At the request of the Surgeon General, the division aided the War Department in testing approximately 10,000 cows supplying milk to camps or cities near them.

Reinforcing other branches of the bureau in charge of controlling work, the Pathological Division dove-tailed its normal activities into the war-time food conservation program. The work of that division is war on disease and on its causes, whether germs or poisonous plants. Thus, all the work of the Pathological Division had an important bearing through conservation channels on the war program.

Since April 6, 1917, the division has distributed 7,743,030 doses of vaccine for immunizing young cattle from its relentless enemy, the blackleg disease. Special efforts were made in the various States to induce a more general use of the vaccine and one State actually compelled by law the vaccination of all susceptible cattle. The Pathological Division met every legitimate demand and request for the immunizing vaccine. In addition, it gave help and advice to stockmen regarding the newer immunizing agencies. These agencies, placed on the market by various commercial firms, were tested for potency and for purity in order that nothing detrimental to the stock should be marketed. Many studies were made to improve the quality of vaccines. A special



laboratory building in which this work will be continued is nearing completion.

Testing of commercial biological products, such as serums, vaccines and bacterins used in the control of animal diseases, was a constant and important line of work during the war, when such products were likely to be manufactured by inexperienced help, due to lack of efficient laboratory technicians who were drawn into the fighting branch of the Army and Navy. Many of these products were found to be lacking in potency, contaminated and distinctly harmful. The office of Virus-Serum Control was furnished this information and such products were withdrawn from sale or were prevented from being placed on sale.

Bacterial Cultures Furnished

Bacterial cultures of various diseases for which the products are used were maintained in the laboratory and, in specific and proper cases, were furnished to manufacturers of biological products for comparative purposes and other legitimate uses. Veterinary laboratories in the Army also were supplied with cultures of certain organisms used in diagnostic work on diseases of horses and mules.

Two thousand two hundred and ninety-five samples of serum from horses and mules were tested to detect latent and obscure cases of glanders, the disease most dreaded in Army animals. Cultures of the glanders organism and other material used in diagnostic work on this disease were supplied direct to Army laboratories to enable the veterinary service to keep glanders out of the Army remounts.

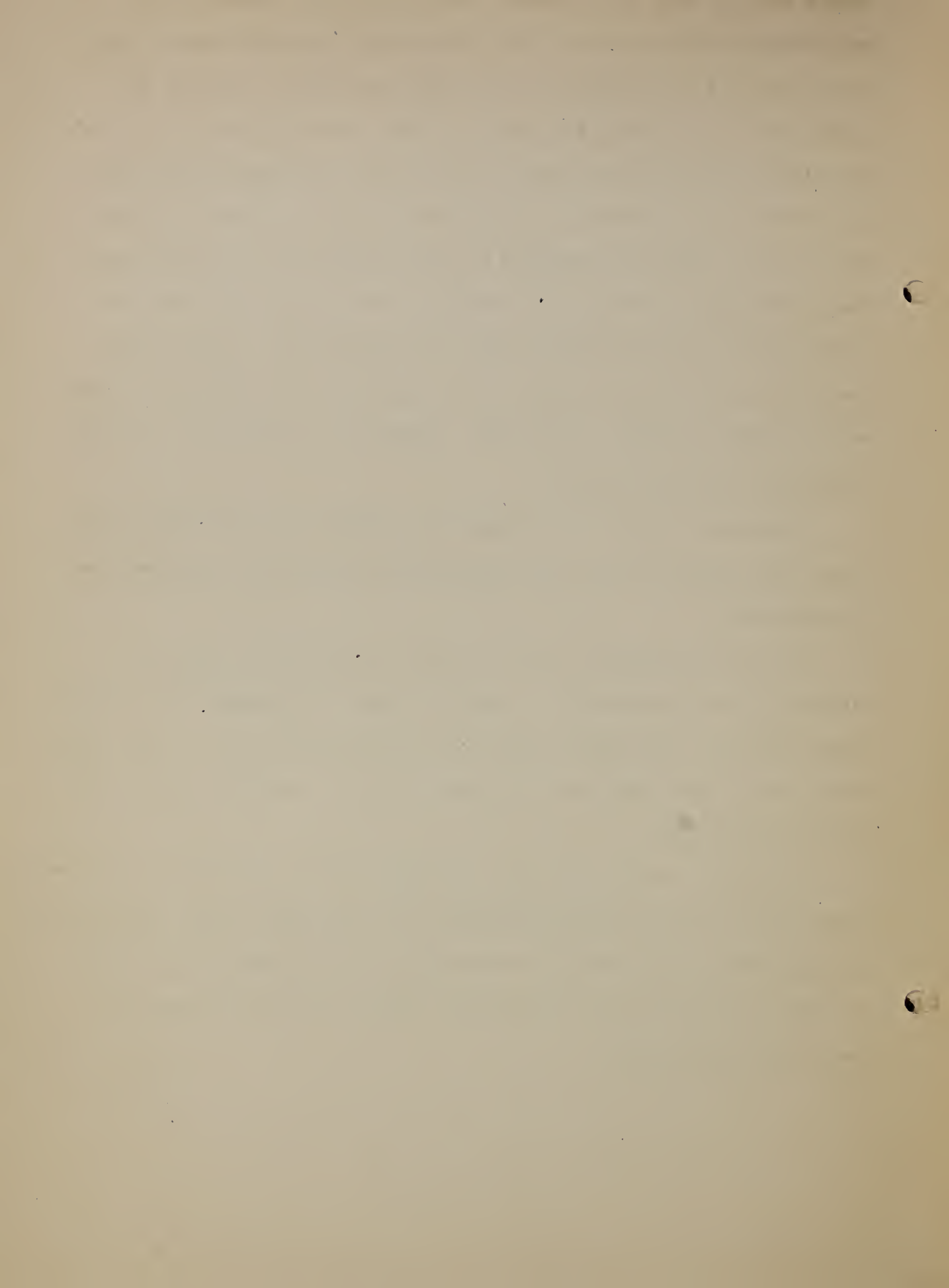
During the last four or five years many thousands of samples of equine blood serum have been examined by complement-fixation to pick out

occult cases of dourine of horses. This disease was a menace to the horse-breeding industry of the West, from which region thousands of Army horses both for this country and the Allies were drawn. There is no doubt that the curbing of this disease at the proper time made it possible to obtain so many valuable horses when the great and urgent demand came. To obviate the possibility of diseased animals getting into Army service, this work was continued throughout the war period, 97,194 samples having been tested after April 6, 1917. Breeding stock obtained for Army purposes was also submitted for the test and in this manner healthy mares and stallions have been secured for such service. By no other means could such assurance be given. In no other laboratory in this country was such diagnostic precision feasible.

Aside from the testing of samples from animals for the United States Army, many hundred of tests were conducted for the Allies, Great Britain in particular.

Due to the movement of horses and mules interstate to the sales stables in the large markets, a number of tests for glanders were made for State officials. The bureau endeavors at all times to lend its full cooperating force in the suppression of animal diseases, and during the war such work was imperative.

Contagious abortion of cattle, a disease which looms great as a deterring factor in both milk and meat production, has been under careful investigation. Some important facts have been uncovered and old knowledge of the disease has been verified through rediscovery. Information on the disease has been widely distributed.



Hemorrhagic septicemia, a contagious disease of cattle, has been widely prevalent. The Pathological Division recently made available a bulletin which gives the salient facts regarding that disease. It was found also to be widely disseminated in the Rocky Mountain region among sheep, and vaccine methods for controlling it were put in operation with apparent success.

Anthrax of animals put in its unwelcome appearance in various parts of the country. A correct diagnosis is an important factor in its eradication. The division has been on the alert to "nip it in the bud." This accomplishment is an oft-repeated one. Such outbreaks of anthrax are usually controlled by the use of commercial biological products which are indirectly supervised by the laboratory tests to which they are repeatedly submitted.

Anthrax Serum Supplied

The Pathological Division has produced a small quantity of a highly potent anthrax serum which has been supplied on various occasions for anthrax in man. Several of these cases occurred in the Army, due to infected bristles in shaving brushes.

The branch pathological laboratories at Denver, South Omaha, and Chicago, have all done excellent work in routine examination of diseased animal tissues. As meat-inspection questions are frequently involved in such determinations, it has a direct bearing on the question of meat conservation. Where performed for veterinarians or stockmen, the question of animal conservation enters.

In the poultry industry, disease is an enemy which has to be warred on constantly. This effort was aided by the Pathological Division through

the dissemination of knowledge contained in Farmers' Bulletin 530, entitled "Important Poultry Diseases," which was revised and enlarged.

Through letter correspondence, poultry raisers were given a mass of information on the treatment of poultry diseases.

Investigation of the plants poisonous to animals was continued. During 1918, an unusual effort was made to bring the results of experimental work before stockmen and to urge upon them every possible means of reducing the losses, which under ordinary circumstances are very heavy. This was done partly through the press and partly by addresses before various organizations. In these addresses, special stress was laid on the importance of conservation. Ordinarily, when the results of investigations are presented to the stockmen, the initiative of acting on the suggestion is left to them. During the war, however, action was urged upon them, not as a matter of choice but as the duty of loyal citizens to save the animals even at extra cost. Reports of losses from poisonous plants indicate that the deaths were much fewer than in preceding years.

A brief bulletin on the stock-poisoning plants of western Europe was prepared for the use of the American Expeditionary Forces and accepted by the War Department.

Exclusion of Contagion from Abroad

With the complex international developments brought about by the war, the bureau's Quarantine Division played an important rôle in continuing its work of excluding contagion from abroad. It also performed war work of specific character under the Act of Congress approved August 10, 1917. Section 9 of that act provided for the importation of

tick-infested cattle from Mexico, South America, Central America, and the islands of the Gulf of Mexico and the Caribbean Sea. Such animals were to be permitted importation subject to immediate slaughter at ports of entry.

The Quarantine Division supervised the administration of the regulations up to the point of delivery of the cattle to the official abattoir at the port of entry, where they were slaughtered under the direction of the bureau's Meat Inspection Division.

The Bureau of Animal Industry aimed during the war toward a high standard of teamwork within its organization, and toward obtaining the desired results at the time needed, thus substantially strengthening the Nation's war position.

THE BUREAU OF PLANT INDUSTRY

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From the beginning of American participation in the war until the signing of the armistice, the Bureau of Plant Industry gave assistance along scores of lines, both directly and indirectly, toward winning the final victory.

War needs emphasized the lack of direct connection between research and extension workers of the States. In response to a call from the States Relation Service, the Bureau of Plant Industry placed extension pathologists in 20 States to work in cooperation with the extension divisions of the agricultural colleges. Some of the definite things they have undertaken are the development of wilt-resistant varieties of cotton, the control of potato late-blight by spraying, and the control of sweet-potato diseases, of tomato wilt, and of other vegetable diseases.

The laboratory of Plant Pathology, as a war activity, made a study of the black-chaff of wheat, a disease that first appeared seriously in Kansas in 1915. It was most serious in 1918 in Iowa and is still confined almost entirely to that region west of the Mississippi River. The study has progressed far enough to make certain the cause of the disease and its identification outside of the wheat plant. The disease is carried on the seed, and control now appears certain by a combination of field hygiene and germicidal treatment.

Plant-Disease Control.

Until last year no extensive or reliable data were available on the yearly losses caused by the diseases of important food crops. The Plant-Disease Survey secured estimates of these losses from pathologists throughout the country, the averages of all reports constituting the most authoritative data ever brought together on the losses by disease of wheat, barley, rye, oats, corn, potato, bean, sweet potato, cotton, sugar beet, and peach. The facts have served as a basis for the initiation of disease-control work.

Special surveys were made covering the root and stalk rots of corn, the sheath-blight (*Physoderma*) of corn, the late-blight of the potato, potato wart, leaf rusts of cereals, and the nematode disease of wheat.

To meet the requirements of the war emergency, the office of Fruit-Disease Investigations found it necessary to modify its usual methods very little in order to make the results available to fruit growers and fruit handlers.

The investigations on fruit rots and decays, especially apple scald, a disease of apples in cold storage which often results in a decrease in the value of the fruit of 30 to 50 per cent, have made striking progress during the last two years.

A great deal of decay and spoilage occurs in small fruits, especially berries, after they leave the producer and before they reach the consumer, the loss often reaching 50 per cent. Investigation showed that most of these losses could be prevented by picking the fruit early in the day, cooling it quickly and keeping it cool, handling it carefully, shipping it promptly and distributing it without delay. A group of

pathologists was organized to study fruits as they arrive at terminals and to advise the inspectors of the Bureau of Markets and others interested as to the nature and causes of decay and spoilage.

Early in 1918, Army officials requested the Bureau of Plant Industry to undertake investigations of pathological defects in airplane timber. But all the assistants trained in this type of work had been taken by the Army. In August, an urgent request that these investigations be taken up came from the Bureau of Aircraft Production. The request was acceded to, and men were taken from other lines of work and trained for the specific task. No quantitative work on pathological factors had ever been attempted before. Hundreds of specimens of tidewater spruce and Douglas fir were rived out in the coastal forests in northern California and shipped to Berkeley, where the tests were made. At the time of the signing of the armistice, arrangements had been completed to extend the work to eastern ash and other hardwoods. The results, it is believed, will be of permanent value for the airplane industry.

Undertakes Sap-Stain Prevention

Sap stains had seriously handicapped gun-carriage manufacture. It was impossible to distinguish between harmless molds and sap stains and serious rots and defects of the wood. Kiln drying, a partial remedy, was not practicable, because it caused the loss of too much time. At the request of the War Department, the office of Forest Pathology undertook the development of modifications of the methods of preventing sap stains. These were based on the use of antiseptic dips and changes in storage methods.

With the outbreak of the war, further attention was given to control

measures as a means of increasing sugar production. Special attention was directed against the two most destructive diseases of the sugar beet, the sugar beet curly-top and the sugar beet nematode. These diseases are more destructive than the others simply because effective control measures have not yet been thoroughly worked out. Considerable progress has been made in determining important factors which have a direct bearing upon the control of the curly-top disease. Important among these are certain life-history facts of the disease carrier and the host plants and habitats of the carrier. The importance of early planting as a control measure has been fully established.

The work looking toward the control of the sugar beet nematode was taken up as an emergency war measure in 1917. This nematode is not a native of this country and undoubtedly was imported from Germany. A large part of the area known to be infested with the nematode has been surveyed and mapped, and the best crop rotations for the control of this pest are being used. The nematode is destroying annually thousands of tons of beets and is rendering thousands of acres of land temporarily unfit for sugar-beet production. Through the emergency work in this connection, sugar-beet culture on many fields has been and is being restored.

When the Food-Products Inspection Act was passed and its enforcement assigned to the Bureau of Markets, the inspectors stationed by that bureau in the various cities were instructed by the pathologists of the office of Cotton, Truck and Forage Crop Disease Investigations in the identification of plant diseases and their relation to the unsoundness or spoilage of the vegetables inspected.

Handbook of Plant Diseases Prepared

A handbook of plant diseases for these inspectors was prepared. The finest series of colored illustrations ever made for such a purpose has been brought together. The publication of these will be of inestimable benefit to plant pathologists everywhere.

Prompt action was taken in cases of outbreaks of plant diseases. Reports of serious injury noted in shipments arriving in the markets are transmitted promptly to the field pathologists, and the necessary action is taken to instruct shippers and growers in methods of preventing future losses.

The office of Soil-Fertility Investigations did a great deal of research work in the preparation of complex and difficult organic compounds, such as those used by the Germans in gas warfare. The men who gave their time to the work risked their health and frequently their lives in carrying it forward. Because of the trained staff of chemists and the unusual laboratory equipment of this bureau, its cooperation was requested at the time of the organization of the American University Experiment Station for gas warfare investigations by the Bureau of Mines. Twenty-one different organic chemicals or "gases" were prepared in the Soil-Fertility Investigations Laboratory, some of which were particularly timely. Shortly after the American Expeditionary Force reached France, a cable message came urging immediate study, for defensive purposes, of the gas diphenylchloroarsine, a rare substance which the Germans had succeeded in making in rather large quantities by a method which produced the compound as a crystalline substance instead of in the liquid form in which it was known to scientists. But 48 hours before the cable

was received from the Army officer in France, the Soil-Fertility Investigations Laboratory had worked out a new synthesis for this gas, and the newly devised method was turned over immediately to chemists at the American University for production and study of the gas.

Equipment Lent to War-Research Organizations

The laboratory of Soil-Fertility Investigations, also was used by the American University Experiment Station in the early days of the war, and some of its equipment, especially the large-scale apparatus, was later lent to the station and to other war-research organizations.

Laboratory facilities, scientific assistance, and advice were given by the Bureau of Plant Industry to the National Council of Research in work for the Ordnance and other divisions in the production of an acetone substance for butyl alcohol, the use of benzolated alcohol in picric-acid manufacture, the use of trinitro-benzene as a substitute for picric acid, and on the purity of acetone and its suitability for certain purposes.

The chemical known as mannite was found to be highly necessary in the medical work of the Army. Before the war, it had been prepared almost exclusively in Germany and had practically disappeared from the American market prior to April, 1917. The Soil-Fertility Laboratory undertook a series of investigations and succeeded in preparing several hundred pounds of this highly essential organic chemical.

Metol is another organic chemical compound which had formerly been prepared only in Germany. It was very urgently needed in the photographic work of the war. The study of its manufacture was undertaken by the Bureau of Plant Industry. A satisfactory method was devised and made available for public use through the issue of a public-service patent.

The force at the Arlington Farm rendered assistance in the operation of a nitrate-fixation plant operated by the War Department. Other important work relating to nitrogen was done by the Soil-Fertility Laboratory at the United States Ammonium Nitrate plant at Perryville, Md. This consisted of chemical greenhouse work on nitrogen-containing by-products of the plant. Advice was given, also, regarding the disposition of a large supply of ammonium nitrate in the possession of the War Department when the armistice was signed.

Another service in connection with nitrates consisted in recommendations made by the Soil-Fertility Laboratory for the partial replacement of ammonium sulphate by sodium nitrate in sugar-cane culture in Martinique and other French possessions. These recommendations were made in connection with the ammonia conservation campaign of the Food Administration; were agreed to by the French High Commission, and approved by the War Trade Board.

Increase Production of Long-Staple Cotton

One of the very acute war needs was for a larger production of extra-staple cotton in Arizona and California. These cottons were necessary for the manufacture of automobile tires, aeroplane wings, balloon fabrics, and other fabrics requiring the greatest possible strength and durability of fiber. The supply was not only short, but its continuance in any quantity appeared doubtful. The production in Egypt had been short for several years before the war, and the importations from that country appeared likely to be shut off at any time by the German submarines. The American Sea Island cotton was in danger of being almost entirely destroyed by the boll weevil. This would have left the new Egyptian cotton industry of the Southwestern

States as the only source of fiber of the required type. In order to avert this danger as far as possible, the office of Crop Acclimatization made investigations and began an active effort to apply in that region the results of the department's previous investigations in the growing of long-staple cotton. The production in the Salt River Valley, Ariz., was doubled in 1918, and considerable plantings were made in other irrigated sections in Arizona and California. Most of the planters did not know either the general cultural requirements for cotton or the special requirements under these new conditions. Except for this supervision, generally unsatisfactory results undoubtedly would have occurred, and the development of the new industry would have been checked, with resultant danger to the military and industrial programs.

Labor shortage gave rise to a series of experiments which have shown that present practices in cotton culture can be modified to save labor. Previous experiments had shown that the branching habit of the plants can be controlled in such a way as to secure earlier and larger crops and to make picking easier. New experiments were made in cultural methods requiring less labor for thinning. Methods were devised for treating the seed to secure regular germination, so that seed could be planted in hills or in check rows with a modified corn planter. Important tests were made, also, in planting cotton with a nurse crop.

Very effective cooperation was given the Gas Defense Service in the development of gas masks. Incidentally, the expeditions that the bureau had previously sent to tropical America to study cotton and corn for acclimatization had gathered much information regarding economic palms. The coconut palm was regarded as the most effective gas mask. But the need

was very pressing, and the scarcity of shipping made it impossible to get the necessary supplies from remote parts of the world. The first-hand knowledge possessed by the Bureau of Plant Industry as to the natural distribution and abundance of wild relatives of the coconut palm in Central America made it possible to open up new sources of supply.

Substitute for Raffia in Making Camouflage

Soon after the American Expeditionary Force reached France, the Bureau of Plant Industry received an urgent request for material to be used as a substitute for raffia in making camouflage. The requirements were met with saw-palmetto leaves and Florida moss, turned over to the Camouflage Corps.

The Bureau of Plant Industry was constantly engaged in the solution of problems looking to the increase of the production of vegetable oils and fats and the better utilization of them. These measures were necessary to meet the constantly increasing demands for materials of this kind for war purposes. The data gathered concerning the sources, uses, and technical processes in the manufacture of these products were made available to the various war agencies of the Government.

As the American aircraft problem developed, it became apparent that castor oil was the only suitable lubricant and that the supply was wholly insufficient to meet the demand. Several million gallons of oil were required, and the available supply in the United States was only about 700,000 gallons.

Castor-Bean Production Increased

In an effort to meet the situation the Bureau of Aircraft Production contracted for the planting of 100,000 acres of castor beans in the southern part of the United States. The castor-bean production had been practically

abandoned many years before, and American farmers of this generation had had practically no experience with the crop. In order to overcome that difficulty as far as possible, the Secretary of War asked the Department of Agriculture to collaborate.

During the crop season of 1918, therefore, the office of Drug, Poisonous, and Oil Plant Investigations of the Bureau of Plant Industry worked with the Army officers detailed to supervise the production of the castor-bean crop. A number of employees were constantly in the field supervising the planting, cultivation, and harvesting the crop and in securing and operating machinery necessary to thresh it. The technology of manufacturing castor oil was worked out for the Bureau of Aircraft Production, leading to the adoption of a process which the trade had considered impossible but which resulted in a pronounced success. A plant designed to utilize this method is now in successful operation.

At one time during the war a scarcity of important drugs was threatened, particularly of belladonna and digitalis, which had been obtained chiefly from Austria and Germany. The Bureau of Plant Industry rendered assistance in developing American sources of supply sufficient to clear up a situation of considerable gravity. At the same time, many persons who had exaggerated ideas concerning opportunities for large profits and were undertaking the culture of drug crops along impracticable lines, were given information by the department which saved them considerable money and effort.

The office of Biophysical Investigations was of service to the National Research Council of the Signal Corps and other branches of the Government engaged in military work. One of the important items was the

construction, at the Bureau of Standards, of a wind tunnel in which any desired wind velocity up to 100 miles an hour could be obtained. It was extensively used in aerodynamical investigations for the Signal Corps and later for the Bureau of Aircraft Production and the Bureau of Military Aeronautics.

Eradication of Common Barberry

One of the most important food-crop conservation measures of the war period was the campaign for the eradication of the common barberry, an ornamental shrub that has been very popular throughout the greater part of the country for many years. Investigations of the Department of Agriculture proved conclusively that the common barberry is the "safe harbor" of black stem rust, a disease that attacks wheat, oats, rye, barley, and many grasses, frequently doing stupendous damage, particularly to wheat. In the great wheat-growing regions of the country black stem rust can not perpetuate itself without the aid of the common barberry or related plants. The spores pass from the barberry to the wheat in spring. If there are no barberry bushes, the rust spores die out. But investigations proved that wheat fields may be infected from barberry at a considerable distance and that the city barberry is just as much a source of danger as the one in close proximity to wheat lands.

In the spring of 1918, the Bureau of Plant Industry began a campaign for the eradication of the common barberry and other rust-susceptible species. The first essential was to tell the truth about the matter in such a way that everybody concerned would realize the necessity for eradication. A widespread and thorough publicity campaign was carried out. Then a State leader and an assistant State leader were placed in

each of the States where rust is perpetuated by the barberry. Usually, they were trained plant pathologists with knowledge of local conditions.

The educational campaign was effective. Not only did grain growers become active in the eradication, but nurserymen, who had rather a large monetary interest in the propagation and sale of common barberry and mahonia plants, cooperated as heartily as the farmers themselves. Thousands of nurserymen have signed pledges not to sell or grow the rust-susceptible species of barberry and mahonia.

In connection with the systematic campaign for the eradication of barberry bushes, either by the owners themselves or by the State police officers, a survey was conducted during the summer and fall of 1918 as rapidly as the diminished number of qualified men would permit. The larger cities were first surveyed and the bushes located in parks and cemeteries and on private and institutional grounds. The campaign then progressed to the smaller cities and towns. The extent of this survey can be appreciated when one considers the miles of shrubbery in parks, cemeteries, and institutional grounds and the hundreds of miles of streets in the larger cities. The clean-up campaign has since been extended to villages, farmsteads, country lanes, and woodlands in which seedlings sown by birds are running wild.

Results Accomplished

The eradication campaign covers the States of Illinois, Iowa, Indiana, Ohio, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Montana, Wyoming, and Colorado. The following figures show something of the results accomplished:

About 85,000 bushes were located during a partial survey in northern Illinois. About 85 per cent of these have been eradicated.

About 95,000 bushes were located in Wisconsin outside of nurseries and exclusive of those growing wild. It is estimated that 90 per cent have been dug.

In Iowa the number of bushes located was approximately the same as in Wisconsin, and about 80 per cent have been eradicated.

In Minnesota about 50,000 bushes were located outside of nurseries, and approximately 80 per cent have been removed.

In South Dakota 25,000 bushes were located east of the Missouri River, and nearly all have been removed.

Accurate figures as to the number of barberry bushes located and removed are not available for the other States.

Aside from the results actually accomplished in eradicating the bushes, the principal effect of the campaign has been the stirring up of public opinion against the common barberry. The effectiveness of the educational campaign is shown by the fact that barberry-eradication bills were introduced in the legislatures of all the States in the eradication area except Ohio and Wyoming. These bills have passed in Iowa, South Dakota, and Montana. North Dakota already had a barberry-eradication law. In Colorado, the crop-pest law gave sufficient legal authority to require the eradication of the bushes, and the Commission of Public Safety in Minnesota issued an order with the force of law requiring the destruction of the bushes.

The Federal Horticultural Board of the Department of Agriculture held a barberry quarantine hearing early in 1919, and the Secretary of Agriculture has since proclaimed a quarantine prohibiting the shipping of rust-susceptible species of barberry and mahonia into the States

named from the other States of the Union and from foreign countries. In the States other than the 13 mentioned, black stem rust is a less serious disease, and the eradication of the common barberry is not regarded as necessary. S

Smut Prevention Through Seed Treatment

Another cereal disease that was helping the Huns very materially is smut. The losses due to smuts in the 1918 grain crops in the United States are estimated at 25,500,000 bushels of wheat, 110,000,000 bushels of oats, and 6,000,000 bushels of barley.

In September, 1917, the office of Cereal Investigations of the Bureau of Plant Industry began a campaign to prevent destructive cereal smuts through seed treatment. The country was divided into 8 districts, and in cooperation with the State extension agencies a leader and a staff of pathologists were assigned to each district. These men began their work during the fall and spring planting seasons in the portion of their districts where seeding is done earliest and continued until seeding was completed in the districts sowing latest. The work was conducted in 43 of the 48 States and has now covered four sowing seasons, the fall of 1917, spring and fall of 1918, and the spring of 1919.

The following table shows some of the results:

Comparative Value of the Smut-Control Campaign from October 1,
1917, to September 30, 1918, Showing Bushels of Grain
Saved and the Increased Profit to Farmers.

	As a result of the campaign.	Cost to	Increased
		farmers of	profit to
		treating	farmers.
		grain.	
Crop	Increase in	Grain saved.	
	treated		
	acreage.		
	Quantity	Value	
	</		

The office of Corn Investigations was instrumental in increasing the world's supply for winning the war by presenting proper seed-corn methods. These facts were effectively presented through personal interviews, correspondence, bulletins, leaflets, and posters. Cooperative work with the extension forces made it possible to bring this information speedily to the attention of farmers throughout the United States.

At the outbreak of the war, the importance of maintaining as nearly as possible a normal production of sugar was recognized. The world's production and consumption of sugar were nearly balanced. As the war was being waged in the sugar-beet areas in Belgium, France, Russia, and Italy, where large numbers of mills were destroyed and the fields were rendered unfit for beet culture, it was apparent that there would be a world shortage. The maintenance of sugar production became at once a serious war problem.

Beet-Sugar Production

While considerable progress was made in increasing the cane-sugar production in the Southern States, the most promising field for the solution of the sugar-production problem seemed to lie in the beet-sugar areas. This was due, in part, to the larger extent of the sugar-beet area as compared with the cane area and the consequent possible increased acreage of beets and, in part, to the possibility of increasing the sugar production per acre. The problem was attacked from the standpoint of a larger acreage, better cultural methods, control of pests, and an adequate supply of high-grade sugar-beet seed.

The office of Sugar-Plant Investigations cooperated with the farmers in the sugar-beet areas, with the beet-sugar companies, and with all State and national agencies interested in food production. As a result of those combined efforts, the largest acreage of beets ever planted in the United States was seeded in 1917. Unfortunately, unfavorable weather and labor conditions prevailed in certain localities, and an abnormally high percentage of the fields were abandoned. However, the crop yielded approximately 750,000 tons of sugar, which tided over a period that otherwise would have bordered upon a sugar famine. The 1918 acreage devoted to beets was somewhat reduced, owing to the demands upon the farmers for such crops as wheat, potatoes, and beans, and the high prices of these commodities. On the whole, the growers responded generously to the call for sugar-beet acreage, with the result that an area in excess of the previous 5-year average was planted. Weather and labor conditions were more nearly normal than in 1917, and only a small percentage of the acreage was abandoned. A sugar crop nearly equal to that of 1917 was pro-

duced, again greatly relieving the sugar stringency. All sugar produced within the United States relieved to that extent shipping facilities badly needed for other purposes.

When it became apparent that there would be an actual shortage in the world's production amounting to several million tons, the problem of conserving sugar became a matter of serious consideration. To meet this situation, attention was given to the production of various forms of sirups. Efforts were made, with gratifying results, to stimulate the production of cane sirup. Attention was given to increased plantings, to better methods of banking cane, to the control of cane pests, to improved cultural methods, and to improved methods of making cane sirup on the farm.

Attention was called in 1917 to a serious cane disease in Porto Rico, which has since been found in this country. An emergency appropriation was made by Congress for its study and control. An experienced man was sent to Porto Rico to cooperate with the local agencies in the control of the pest.

Extension of the Sorghum Sirup Industry

An appropriation was made in 1917 for the study and extension of the sorghum-sirup industry. Prior to the war, the estimated sorghum-sirup production was about 13,000,000 gallons a year. The estimated production was more than 30,000,000 gallons in 1917 and nearly as much in 1918.

The production of maple sugar and sirup was greatly increased over the prewar figures. In cooperation with the Bureau of Chemistry, a palatable sirup was made from sugar beets. Thousands of families supplied themselves in part with sweets from one or more of these sources, thereby conserving large quantities of sugar.

The field men of the office of Dry-Land Agriculture located at 24

field stations in the Great Plains were conducting investigations in methods of crop production under dry-land conditions where cereal production is the chief agricultural industry. They were therefore in a position to assist in many ways in increasing crop production.

In response to a request received through the French High Commission to the United States, the heads of the offices of Alkali and Drought Resistant Plant Investigations, Dry-Land Agriculture Investigations, and Western Irrigation Agriculture visited Algeria during September and October, 1917, to ascertain conditions as to food-crop production in that colony and in what manner the United States could cooperate toward increasing or stabilizing production.

Much work was done in assembling data on the botanical resources of Africa and in preparing a map of that continent showing the principal zones of natural vegetation as indicating the crop capabilities of the different sections.

The Bureau of Plant Industry, through the office of Horticultural and Pomological Investigations, did much to stimulate the development of home vegetable gardening during the period of war. Special bulletins were issued for the North and for the South on city gardens. A special series of articles for use in magazines and papers was distributed through the Office of Information. A special agent was employed jointly with the States Relations Service for handling vegetable-gardening information through State leaders and county agents. Special advice was furnished county agents and leaders of States in which large quantities of vegetables suitable for storage were produced. Suggestions regarding the cooperative handling of the products of community gardens through mill owners and others were carried out.

Special attention was given to the utilization of vegetable forcing plants, to minimize fuel consumption, and to produce maximum crops. Advice regarding the use of fuel by greenhouse operators for both vegetables and flowers was furnished the Fuel Administration, and advice concerning crop rotations was given to vegetable growers.

Supervise Agricultural Work at Cantonments

Around practically all the Army cantonments there were considerable areas not used for military purposes, but which could be used for the production of food and feed. After conference with the Quartermaster's Office, a member of the staff of the office of Horticultural and Pomological Investigations was assigned to this work under commission and, until the close of hostilities, supervised agricultural work at the cantonments. In this way, several thousands of acres of land were profitably cultivated. The same agencies also cooperated in the development of cold-storage facilities at the camps.

The landscape gardener of the Bureau of Plant Industry assisted the Army and Navy in laying out grounds used for recreation at camps, hospitals, and other places.

In connection with reconstruction work for soldiers at the various hospitals, many suggestions were furnished by the War Department as to agricultural occupation.

Previous to the outbreak of the war, some attention had been given to the drying of vegetables, including potatoes, and this work was undertaken on a larger scale in this country for the benefit of the English and French Armies soon after the beginning of the war in Europe. Anticipating the shortage of food crops, investigations were made to determine the comparative value of the simpler types of drying apparatus for handling fruit and

vegetable products. Demonstrations were carried on in several counties in New York State where potatoes were available in abundance and where fruit-drying houses were located. By slightly modifying the construction of these houses and employing mechanical peeling and slicing devices, it was possible to produce a dried potato which, when ground in the ordinary feed mills available to the country districts, turned out a potato meal that gave very satisfactory results in the manufacture of yeast breads.

Salvaging of Fruit and Vegetable Crops

Instruction was given in the salvaging of fruit and vegetable crops which could not be satisfactorily marketed because of the lack of transportation facilities. In regions where there were large crops of perishable fruits which could be dried either by means of the sun or special equipment detailed demonstrations were made.

In addition to participation in the general war activities of the department, the Chief of the Bureau was designated a member of a commission of four to determine the values of property taken by Presidential proclamation in Harford and Baltimore counties, Md., for the establishment of the Aberdeen Proving Ground and Edgewood Arsenal. The tract involved comprised somewhat more than 40,000 acres of land fronting on Chesapeake Bay and its tributary rivers, including the homes of some 3,000 people, numerous highly improved farms, canning factories, schools, and churches, as well as several of the leading duck-shooting grounds of the Middle Atlantic coast and a large area of forest land. The urgency of the munition situation overseas required the utmost expedition in the clearing of the tract of its inhabitants, which was practically accomplished between October 25 and December 31, 1917, under conditions involving a minimum of financial loss and physical hardship to

them.

In August, September, and October, 1918, the Chief of the bureau, as a member of an Agricultural Commission designated by the Secretary of Agriculture, investigated agricultural conditions in Great Britain and France to secure information needed in shaping the crop-production program for 1919. The results attained were briefly summarized in the report of the Agricultural Commission to Europe, published by the department on January 17, 1919.

For the last two years the Associate Chief of the Bureau of Plant Industry has served as Secretary of the Agricultural Committee of the National Research Council, which committee also served as Agricultural Advisory Committee to the Council of National Defense.

THE BUREAU OF CHEMISTRY

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Chemistry is one of the most important sciences, if indeed it does not stand absolutely first in this regard, in the conduct of modern warfare. Naturally, therefore, the Bureau of Chemistry of the United States Department of Agriculture, having a large staff of trained chemists and being equipped to render service along many lines, was called upon to perform a great deal of war work immediately after the beginning of hostilities.

These lines of work took about six main forms, - conserving essential materials, preparing specifications for materials of war, testing supplies for the Army and Navy, making technical investigation of war problems, and service in consultation and on committees.

From the outset, very many, both of old agencies and new ones created for the performance of specific war tasks, called on the Bureau of Chemistry for assistance. The Food Administration asked for aid in creating its organization, in gathering data regarding food supplies, and in technical advice regarding manufacturing processes and possible substitutes for foods. A large number of men were detailed from the Bureau of Chemistry to the Food Administration for important tasks. Among them were experts in baking and the use of flour substitutes, in the conservation of fats and oils and in various other lines of food conservation. The Bureau of Chemistry organized the bakery inspection service of the Food Administration and, through the use of its own and State cooperative organizations,

made it possible to enforce the regulations regarding the conservation of flour months before this result would have been possible in any other way.

Department Chemists Prompt to Aid

Many of the War boards and other agencies called on the Bureau of Chemistry for specialists and for technical advice, and detailed members of their own staffs to the Bureau to receive instruction in technical methods. Among the organizations with which one or more of these forms of cooperation was maintained are the War Trade Board, the Railroad Administration, the Bureau of Aircraft Production, the Council of National Defense, the Quartermaster Corps of the Army, the Ordnance Bureau, the Camouflage Section of the Engineer Corps, the Chemical Warfare Service, the Sanitary Corps of the Army, and the Gas Warfare Service.

Chemical apparatus, pharmacological apparatus, chemicals and scientific materials, which could not have been obtained through regular channels without months of delay, were furnished to the various war agencies, and laboratory space and facilities were placed at their disposal.

One of the most important lines of war work and one in which the numerous agencies of the Government cooperated, was the conservation of essential materials. In the various kinds of work done along this line by the Department of Agriculture, none was of greater or of more far reaching importance than those carried on by the Bureau of Chemistry.

Before the outbreak of the war, the Bureau of Chemistry had given much attention to conserving tin plate. The problem became acute at the beginning of the war, since the impending scarcity of containers would have interfered seriously with the preservation of the various perishable food products of this country. The Secretaries of Agriculture and Commerce, in

cooperation with a committee representing the manufacturers of tin plate, manufacturers of cans; packers of perishable and nonperishable foods and other interested parties, took up questions of policy in this matter and made recommendations to the industries, curtailing the pack of certain non-perishable commodities. The Chief of the Bureau of Chemistry was designated as the representative of the Department of Agriculture on this committee. The tin plate committee was able to effect a great conservation of tin plate for use in preserving more perishable products and preventing, as far as possible, congestion of the transportation facilities and related difficulties which would have followed if unrestricted canning of all sorts had continued. As soon as the Food Administration and the Priorities Board were created, the work which had been previously done by the tin plate committee was handled with ample authority in law by these two organizations.

Acetic Acid from Alcohol

On the recommendation of the Chief of the Bureau of Chemistry, an Interdepartmental Ammonia Committee was appointed to arrange for the control of the production and distribution of ammonia in this country. He was appointed a member of the committee. The licensing and execution of this control was carried on by the Food Administration. It was a matter of much importance, since an equitable distribution of ammonia was necessary if both the refrigeration and explosive requirements of the country were to be met. Methods were suggested to certain industries as to possible means of conserving ammonia.

On the recommendation of the Bureau of Chemistry, steps were taken to control the distribution of arsenic and related compounds. A committee

was appointed for this purpose. This action led to the licensing of the arsenic industry by the Food Administration. The control of these products was necessary so that neither the loss of foods by the lack of insecticides and fungicides nor the crippling of the program for gas warfare service should occur for the lack of arsenic. Analysis was made of a large number of insecticides for use for different military purposes.

An investigation was conducted by the Food Control Laboratory to develop practical methods for the conversion of alcohol into acetic acid. At one time, the control by the War Department of the acetic acid supply threatened to make it impossible for Paris green to be manufactured. The Bureau of Chemistry assisted in introducing the use of distilled vinegar for the manufacture of Paris green instead of acetic acid, thus insuring a sufficient supply of this essential insecticide.

The Food Control Laboratory furnished information to the National Research Council relative to certain fermentation processes, especially the production of acetone by fermentation.

At the request of the Surgeon General's office and the War Industries Board, a careful study was undertaken by the Phyto-Chemical Laboratory of the plants in the United States available for the preparation of caffeine on a commercial basis.

Considerable work was done by the Food Control Laboratory in cooperation with the Food Administration in regard to garbage disposal and utilization.

Many New Food Processes Presented

Information was furnished the Food Administration relative to the brewing of beer in order to assist in the program of conserving grains.

Information was furnished the United States Shipping Board relative to the domestic production and consumption of fusel oil.

An investigation was made at the request of the Quartermaster Corps of the Army of the effect of calcium mono-phosphate in an aluminum phosphate baking powder to ascertain the practical leavening results of the presence of lime phosphate when mixed in amounts from 1 to 10 per cent.

A research was conducted for a cellulose acetate solvent for use in airplanes.

A study was made of the determination of some of the forms of nitrogen in explosives and an exact method was developed for the determination of nitrogen in organic combinations.

During the war period, the Carbohydrate Laboratory was active in the investigation of a number of new sources of supply of sweet sirups to relieve the sugar shortage caused by the war shipping situation. A very palatable and satisfactory sirup was prepared from raisins. Fairly satisfactory sirups were prepared from the juices expressed from green corn stalks and by the acid hydrolysis of sweet potato starch. A number of other sources were investigated, including sotol, a desert plant native to the arid regions of the southwest.

Investigations were conducted looking toward the stimulation of the use of fresh fish in inland cities in order to conserve meat and other nitrogenous food products. Improved methods for shipping fish were developed. In the State of California, considerable work was done toward

introducing improved methods in preserving the fish native to the Pacific Coast. As a result of this work, this fish industry has become established on the Pacific Coast. The use of fish has been stimulated and better methods for packing, shipping and handling it have been introduced to the trade.

Substitutes for Flour and Sugar

An extensive educational campaign was conducted to introduce into more general use the improved methods developed by the Food Research Laboratory of the Bureau of Chemistry for the handling, packing and shipping of poultry and eggs. As a result, the loss of much poultry and large quantities of eggs was prevented. Through cooperation with the Food Administration, State and City Food and Drug Inspectors, and the regulatory force of the Bureau of Chemistry, a campaign to bring about the more general candling of eggs near points of production was inaugurated and carried on during the period of the war. This work not only prevented a loss of large quantities of eggs, but conserved shipping facilities.

The regulations issued by the Food Administration regarding flour substitutes were based largely upon information furnished by the Bureau of Chemistry. Experts had been working on flour substitutes for a number of years before the United States entered the war and were in a position to furnish the Food Administration with specific formulas as to the proportions in which various substitutes could be used in baking. One of them taught the Army cooks how to bake with various substitutes. Complete information on the subject was furnished commercial bakeries throughout the country. The work on flour substitutes was made known to the public generally

through the popular publications of the Department of Agriculture; through lectures and demonstrations; through county agents of the States Relations Service, a large number of whom visited the bureau in regard to this work; and through conferences with the members of the Food Administration. The work had an important bearing on the saving of wheat that resulted from the measures adopted by the Food Administration.

A great shortage of sugar necessitated a study of other sweetening agents to replace sugar in the manufacture of soft drinks. Over 100,000 tons of sugar is used annually in the preparation of soft drinks. It was demonstrated by experiments in the Bureau of Chemistry that probably 50,000 tons of this sugar could be saved by utilizing other sweetening agents. After laboratory experiments had demonstrated that this saving could be effected, the information was furnished to the trade through articles published in trade journals, through lectures, and through the distribution of about 30,000 leaflets to bottlers and others interested. A great many commendations have been received from soft drink manufacturers regarding results which were accomplished, some asserting that the timeliness of the information issued by the bureau saved the soft drink industry, represented by 11,000 bottlers and a capital of \$250,000,000, from great loss if not serious disaster.

Economies in Fats and Oils

Investigations were made looking to the conservation of fats and oils which are not only a necessary part of the food supply but occupy an important place in the manufacture of munitions, in the lubrication of aircraft engines, and in paints, varnishes and water-proofing compounds. One of the first resources to feel the effect of war was the stock of fats

and oils. This was due to the imperative need for an enormous amount of nitro-glycerin, one of the component parts of which is glycerine obtained as a by-product from the manufacture of soap from certain oils and fats. When it is considered that but one part of glycerine to every nine parts of fatty acids or soap is produced from the oils and fats, it is not surprising that the price of glycerine in England soared from \$250 to \$1,250 a ton within a very short time after the beginning of the war.

Economies in the way of oils were recommended. Vegetable oils were used in ever increasing amounts to supplement the animal fats and oils. Some, like cottonseed oil, make a satisfactory substitute for part, at least, of the animal fats and such products as lard oil. Some of the less well-known vegetable oils, like peanut and corn, grew rapidly in public favor as substitutes for olive oil. Small butchers and farmers were urged to trim the animals they slaughtered closely to obtain all the fat possible for rendering as lard or tallow. The housewives were urged to be as economical as possible in the use of animal fats. The question of recovering fatty matter from garbage and trade waste was investigated. The use of hydrogenated cottonseed oil as a substitute for palm oil was studied.

As a result of a large number of fires occurring in the cotton gins of the southwest, an investigation was carried on to determine the cause or causes of these fires, and, if possible, to develop means of prevention. During the season, 471 gins were visited. It was found that 287 of these gins had, during the season, a total of 607 fires. Among the gins visited there were only 184 that had not had fires. During the course of the investigation, as much information as possible was obtained from all the gins regarding the fires and the general conditions under which they had occurred.

Matches are popularly supposed to be the chief cause of these fires. However, as a result of two separate tests when over 500 matches were fed into cotton going into gins, no fires were obtained in this section of the gin, and only four small fires were obtained in the huller press. This indicates that matches are not responsible for the large number of fires credited to them. As a result of the investigation, it was determined that static electricity is probably the primary cause of these fires.

Millions Saved in Grain and Cotton Fires

Experiments were made to see if cotton would be ignited by static electricity and it was found that it would be readily ignited by a spark not over a quarter of an inch in length. During the season, over 25 gins in different sections of the country had been grounded to remove, if possible, the static electricity generated in the normal process of ginning. Those which have reported show conclusively that the grounding has greatly decreased the number of fires occurring in the gins. It is believed that further investigations are necessary to solve this problem conclusively.

A campaign to prevent explosions of grain-dust originated in 1918, following a disastrous explosion and fire in the Dow Storage Elevator, Brooklyn, New York, in which a large quantity of grain was destroyed and considerable damage done to property. Steps were taken to secure a competent organization of well trained men in order to carry on this work. In order to thoroughly acquaint the grain trade throughout the country with the results of the investigation which had shown the cause of the explosions, meetings were held in the principal grain centers throughout the country. By means of lantern slides, motion pictures and miniature dust explosions, the re-

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results were brought to the attention of millers and grain men. Steps were taken to secure the assistance and cooperation of the workmen. Plans were made for the field men to visit the mills and elevators throughout the country and present personally the work that the department is doing and to impress upon the men the necessity for exercising precautions to prevent these explosions and fires.

The results can be briefly summarized as follows:

1. The work has been well received by the milling and grain trade and the department has had active cooperation in the conduct of the campaign.
2. The campaign has resulted in the adoption of precautionary measures and the removal of dangerous conditions that would lead to explosion and fire.
3. Active and hearty cooperation has been manifested by the workmen in their effort to assist the Government in conserving the food supply and thereby winning the war.
4. No explosions of large proportions have occurred during the conduct of the campaign for a period of over 15 months, while during similar periods since the origin of the work in 1913 from one to six disastrous explosions have occurred in grain mills and elevators.
5. The campaign has resulted in a reduction of the losses due to fire and explosion and a grain journal recently stated that in 1918 there were 33 per cent fewer elevators destroyed by fire and about 44 per cent fewer damaged.
6. The field men during the campaign will have visited every mill in the country of 100 barrels and over capacity and every elevator of 50,000 bushels or over capacity. As a result, dangerous conditions are removed and efforts made on the part of the companies to adopt the department recommendations.
7. Since the conserving of food and the furnishing of food to the Allies by America has been recognized as being responsible to a very large degree in winning the war, it is felt that this campaign was one of the most active agencies in making it possible for the protection of grain in mills and elevators and the prevention of its destruction by fire and explosion.

Grain Dust Explosions Checked

A special educational campaign was conducted to acquaint threshermen and farmers in the grain growing sections of the country with the methods that had been developed by the department for the prevention of explosions and fires. About 30 specially equipped demonstrational and experimental machines were provided by the thresher companies and located in five grain growing sections during the threshing season.

In addition to the special demonstrational equipment, a popular circular, poster and correspondence card were prepared. This literature was given wide distribution through the States Relations Service and thresher agencies in order to bring to the attention of the threshermen the necessity for exercising precautions against fire and explosions.

Previous to the beginning of the season, a large number of meetings were held in the Pacific Northwest. The work was presented by means of lantern slides, motion pictures and dust explosion demonstrations. As a result of this special educational work, a large number of threshermen and farmers adopted precautions to reduce losses. The results of the thresher campaign may be summarized as follows:

1. Greater precautions were adopted during the 1918 season by the threshermen and farmers throughout the country to prevent these fires and explosions than in any previous season.
2. As a result of the campaign by the department the losses due to explosions and fires were greatly reduced and damage to large quantities of grain accordingly prevented.
3. While it is impossible to estimate the amount of grain saved in bushels, it is felt that in conjunction with the work done by the Food Administration, a large quantity of grain was saved which would otherwise have been destroyed by fire, or lost from other causes.

4. The measures developed by the department for the prevention of explosions and fires led to the possibility of improving the quality of grain during threshing and also the development of methods for the collection and disposal of smut spores, thereby diminishing the possibility of soil infestation.

Dehydration Work Benefits Peace Times

The dehydration of fruits and vegetables is an important industry in war time and promises to become commercially important in times of peace. Before the United States entered the war, the Allies were in the market for large quantities of dried food products and considerable study was made by the Bureau of Chemistry of processes for drying. The problems involved in the process of drying are principally those of securing scientific control of temperature, humidity and air currents. When the United States entered the war, the great possible saving in shipping space and facilities by the use of dried vegetables was pointed out to the War and Navy Departments. Because of an unfortunate experience which the Navy Department had several years before with improperly dried food products, both departments were reluctant to use them. However, the acuteness of the shipping situation and evidence furnished by this bureau showing that food, when properly dried and packed, was both palatable and nutritious, later led the Army to buy large quantities of dried vegetables.

An appropriation of \$250,000 was made by Congress in the Agricultural appropriation act for the fiscal year 1919 which became available in October, 1918, for investigations looking to the establishment of a commercial drying industry in the United States, as well as to make available sufficient dried foods for the Army. An officer was detailed from the Sanitary Corps of the Army to cooperate with the Bureau of Chemistry in directing this work.



The War Department requested the Bureau of Chemistry to recommend materials for waterproofing Army shoes. Practically all of the commercial waterproofing materials for leather which are in use in this country were tested for their waterproofing qualities, and many samples both of treated and untreated soles and insoles were tested. This work took the full time of three of the analysts of the Leather and Paper Laboratory. Few commercial waterproofing materials had a high waterproofing value and many of them were directly harmful either to the leather or to the sewing thread. It was necessary to prepare new formulas. About sixty were devised and tested and from these a number that proved satisfactory have been adopted and used by the War Department for the waterproofing of shoe leather. The bureau also recommended preparations which were suitable both for shoe dublings and for ointments to be used for trench foot.

Preserving Shoes and Harness

The Ordnance Department requested assistance in finding leather which would stand the high temperatures likely to occur in the recoil mechanism of guns where leather gaskets are immersed in heavy mineral oil at exceedingly high temperatures. Investigation showed that chrome tanned leather of a high chromium content and of low moisture content would be satisfactory. The Ordnance Department, as a result of the report of this work, secured leather that was satisfactory for that purpose.

Investigations were made for the Quartermaster Corps and the Ordnance Department on harness dressings and in finding substitutes for neat's foot oil for this purpose. Extensive experiments on the effect of oils, greases and waxes, and various experiments on upper, sole and harness leathers were carried on. In addition to the value of this information for war purposes,

it will be of great use both to tanners and users of leather. Investigation was made of the effect of offensive gases on upper leather.

The chemist in charge of the Leather and Paper Laboratory assisted the War Department in investigations on the waterproofing and mildewproofing of fabrics. War Department contracts for such fabrics were let on the basis of the results of this investigation. The waterproofing and mildewproofing formulas recommended by the bureau worked out on a commercial scale with highly gratifying results. At the request of the Conservation and Reclamation Division of the Quartermaster Corps, a member of the Leather and Paper Laboratory force visited several Quartermaster Depots of the Army to study waterproofing treatments and report methods which were being used. As a result, the methods of waterproofing were materially improved and cheapened.

Waterproofing for Tents and Paper

Investigation was made of adhesives for tent patching and, as a result, several preparations which had been found to be of exceptional merit were adopted and used by the Conservation and Reclamation Division in patching and repairing tents.

An investigation was made for the Ordnance Department at the New York and Philadelphia depots, of waterproofing baling papers for overseas shipments. Goods were actually baled and the bales submitted, both dry and wet to severe handling. On the basis of the behavior of the waterproof paper and on laboratory tests, specifications for baling paper for overseas shipment were adopted by the War Department. The matter of baling and the use of waterproof papers for the purpose is one of great importance. It has been claimed by the War Department that baling of goods for the Army has saved at least half of the shipping space previously required, and that this saving

has been equivalent to \$50,000,000 to the Government. Undoubtedly, bales will prove more economical than boxes for commercial goods. Manufacturers of baling paper are taking up the matter of furnishing materials for baling commercial packages in the future. Recommendations were made for a paper to be used in wrapping tools and metal parts to prevent rusting in overseas shipments.

Investigations were made on the manufacture of fiber containers as a substitute for steel for powder and other propellant charges. Large numbers of fiber containers for powder were purchased by the Ordnance Department. Careful investigation, however, developed that these would not be satisfactory for the purpose, since an increase of a fraction of the percentage in the moisture content of the powder would entirely change the trajectory of the shell and cause it to fall short, thus perhaps exposing American soldiers to the fire of their own artillery. Recommendations were prepared for several types of containers for the Navy Department.

The Chemical Warfare Service sought the aid of the Bureau of Chemistry in securing suitable canister fillers that were sufficiently porous for use in gas masks. A high grade blotting paper was furnished which was more satisfactory than anything that had been used and from which a satisfactory filling material for the absorption of gases was secured.

An investigation was made for the Camouflage Section of the Engineer Corps of methods for fireproofing fabrics and vegetable matter used in camouflage work. Camouflage material is particularly liable to catch fire and thus reveal the location of supplies and forces on the battle field.

Gives Standards for War Purchases

Because of its long experience in testing various materials for the Government departments, as well as foods, drugs and chemicals in its own work, the Bureau of Chemistry was in position at the outbreak of the war to aid the purchasing agencies of the War and Navy Departments in preparing specifications for many of the materials which it was necessary for them to purchase. The preparation of specifications that will enable the Government to secure the kinds of materials needed for every purpose is a work of vital importance, especially when the Government has to buy immense quantities from different sources and from people who have vague ideas of the purposes for which the materials are to be used. Without adequate specifications, the Government would have been supplied with immense quantities of goods which would not answer the purpose, causing much loss in time, materials and transportation facilities. Assistance was rendered the Quartermaster Corps in preparing specifications for food products, since the bureau had accumulated in connection with its work in the enforcement of the Food and Drugs Acts much data in reference to definitions and standards for foods.

In addition to preparing specifications for supplies, the Bureau of Chemistry was called upon to analyze and test many articles of supplies furnished to the Army and Navy. The Quartermaster Corps of the Army, in the beginning, desired to organize its own testing laboratories but after a short time abandoned this plan and called upon the Bureau of Chemistry, to test such foods as required chemical analysis. All the field laboratories of the bureau located in the trade centers throughout the United States, as well as the laboratories in Washington, were made available for this purpose.



A laboratory was installed in Atlanta, Ga., for the sole purpose of testing foods for the Army. The bureau had not only well equipped laboratories and a large staff of experienced food and drug analysts, but by years of experience had developed the most efficient and economic methods of analysis for all ordinary food products. As it was necessary to continue at the same time the analytical work involved in the enforcement of the Food and Drugs Act, the Quartermaster Corps detailed a number of chemists to the laboratories where most needed to assist in the testing of foods. This work was given precedence over all other testing work, and reports were made as promptly as practicable.

A large number of other articles were tested. The Miscellaneous Laboratory made tests of insecticides for the various branches of Military Service. Analyses were made of a large number of soft drinks for use in military camps. Tests were made of harness leathers for the War Department, greases and tanning materials for the Quartermaster Corps, the castor oil and beans imported into this country for the Bureau of Aircraft Production, the efficiency of various photographic chemicals, tin foils and collapsible tubes for the War Industries Board, food cans made from untinned steel and treated by a rust-proofing process, castor bean hulls to determine if they contained potash in available quantities for the Aviation Corps.

Aid for Airplane Photography

The following list of materials tested by the Microchemical Laboratory will illustrate the great variety of products handled by the bureau, although it does not include all substances tested by other laboratories: Beans, bread, cakes, cookies, candy, cereals, cheese, chewing gum, cocoa, cloths, coffee, corn, cream, drugs, emergency rations, fish flour and meal, foot

powder, hospital gauze, glass, hair from life preservers, ice cream and ices, insecticides, jams, middlings, marmalades, oakum, paper, peanut butter, pudding, salad dressing, soaps, spices, starch, stock feed, sugar, sweet potatoes, tapioca, tomato products, twine, and yeast.

To aid in the detection of adulteration in foods, a portfolio of about fifty photo-micrographs of food products was made for use of the Sanitary Corps of the Army.

Technical investigations of war problems were conducted along numerous lines. The work on sensitizing dyes was undertaken at the solicitation of the Photographic Section for the purpose of developing dyes necessary to the sensitizing of gelatine emulsions. Dyes of this character had been produced before the war only by German concerns. After the beginning of the war, the development was undertaken by Great Britain. These dyes are employed in airplane photography for the purpose of making visible objects not photographed upon the ordinary plate, especially in adverse conditions of the atmosphere. A large number of dyes of this type were prepared in considerable quantities. The best dye of the pinaverdole type has been developed to a point where the production of large quantities can be carried on at any time. The study of the dicyanine dyes is progressing in a very satisfactory manner and there has been produced in considerable amounts a dye that sensitizes to a very marked degree in infra red.

Arrangements have been completed for the continuation of this work in the Color Laboratory of the Bureau of Chemistry where the dyes can be made available to manufacturers and users, since the Bureau of Chemistry has authority by law to dispose of chemicals of this nature. The Color Laboratory



proposes to extend the study of the dyes of this series with a view to fixing their constitution and chemical properties. Dyes of this class have much scientific value in making possible the study of the spectrum in the infra red region where photographic methods have not been applicable.

Developing Airplane Smoke Screens

Dyes for use in color screens have been studied. It is especially desirable to develop a color screen capable of distinguishing live and dead leaves, iron rust and, in general, shades of red and green. Several new dyes have been investigated and some very satisfactory results have been obtained in the preliminary studies.

A new process for the manufacture of secondary alcohols from the waste gases of the petroleum industry has been studied and successfully developed by the Color Laboratory. The process is most promising.

Increase in the production of the valuable war materials, acetone and ketones, was undertaken by the Color Laboratory. The waste gases from certain gasoline processes in use in the petroleum industry have been studied for the production of secondary alcohol. These alcohols can be converted into acetone and a commercial process for carrying on this chemical reaction has been developed. From this investigation, there promises to be developed a new source of acetone that will result in cheapening this valuable chemical. There is promise of development of a large industry which, to a considerable extent, may supersede the wood distillation industry and, directly or indirectly, affect the manufacture of many aliphatic chemicals.

Smoke screen investigations were made, the object being to study the development of smoke screens from airplanes for the purpose of obscuring

planes in flight and to place a cloud over the landscape to obscure terrestrial movements from air observation. The work has proven that it is almost impracticable to attempt such operations on a large scale, on account of the large weight of materials involved, but as a result of the studies new methods of signalling by means of volatile dyes and a method of imitating a plane on fire have been successfully developed.

Gas Mask Work Invaluable

The Medical Corps of the Air Service, in connection with other investigators, brought to the attention of this Bureau the great utility of certain dyes in the studies of blood. One of the most valuable of these has been prepared, submitted for investigation and proved to be of great use. Steps have been taken to prepare this dye in large quantities. There seems to be sufficient assurance that it will become available in the near future and that it will greatly assist medical investigations.

Much of the fundamental work for Gas Defense Warfare, on the absorption of toxic gases by charcoal was done by the Carbohydrate Laboratory and the Color Laboratory. This work had a very wide scope and has been of fundamental importance. It included the preparation and investigation of the properties of charcoal derived from a very large number of natural organic materials, since the gas-absorbing power of char prepared from any one source varies greatly with the method of carbonization. It included the study of a large range of methods for treatment of the organic materials during carbonization. The Bureau of Mines cooperated with the Bureau of Chemistry. The work was carried on for a period of nearly two years and assisted in the development of a gas mask that was more efficient than any other mask in use by the Allies.

The Carbohydrate Laboratory has been the source of supply of rare carbohydrates for bacteriological research for a number of investigators working in collaboration with the Army Medical Department. The rare carbohydrates are valuable and essential reagents used by the bacteriologists to differentiate between closely related strains of bacteria. During the war period, many of these reagents could not be bought from chemical supply houses. Just prior to the signing of the armistice, arrangements had been completed with the Army Medical Department to enlarge very materially this function of the Carbohydrate Laboratory.

An investigation of the explosive properties of pure nitro-dulcite and nitromannite, in cooperation with the Research Division of the Chemical Warfare Service, was carried on by the Carbohydrate Laboratory. Nitro-dulcite and nitromannite appear promising as detonators and as sensitizing agents in the production of high explosives and may eventually find extensive application. The investigation, so far as completed, included the development of an electrolytic method for producing dulcite, study of the proper conditions for nitration of dulcite and mannite and processes for the purification of nitro-dulcite and nitromannite. Nitro-dulcite may be used as a booster-charge in loading shells.

Detect Ground Glass in Food

The Department of Justice submitted a large number of samples of foods for examination to determine whether they contained poison, ground glass or other harmful substances. Many others were submitted by State Officials. Private individuals sent to the bureau a large number of food products which they believed had been tampered with. All such samples were tested. In most cases, the results were negative.

Miscellaneous technological investigations were made including a micro-chemical study of trench lice powders for the War Department, color investigations on the absorption of chlorine by charcoal developing a new process for the manufacture of hydrochloric acid from chlorine; a study of the effluents from camp sewers; an investigation of poisons commonly employed in exterminating rats; tests on the toxicological action of hardwood tar preliminary to its being tried against body vermin on soldiers; investigations of solder of 80 per cent lead, 10 per cent tin and 10 per cent cadmium to determine if it was suited for use on the side seams of cans; investigations upon the operation of a number of plants producing materials required in airplane manufacture, especially certain alcohols and ketones, and investigations of some of the esters of lactic acid to determine whether they would be valuable as solvents in the manufacture of airplane dopes.

A study was made by the Water Laboratory to determine the value of the Loewig Process for the production of caustic soda. The demand for caustic soda, due to war activities, was so great that there was an estimated shortage of something over 100,000 tons a year. It had been suggested to the Council of National Defense that possibly the Loewig Process could be utilized for increasing the supply without seriously interfering with other operations and by using equipment which was already available. Inquiry was also made to determine if other materials might be used either to replace caustic soda or if the raw materials could be utilized by the consumer so as to reduce the demand especially for household purposes and as a cleansing agent in bottling establishments, machine shops, etc. A report was submitted to the Council of National Defense of the relative cost of the raw materials and the kind of package which could be used in packing them, and directions were



furnished for the use of the raw materials in such a way as to produce caustic soda.

The bureau of Chemistry assisted in the organization of the Food Division of the Sanitary Corps of the Army, of the Gas Warfare Service and of a number of the boards and committees charged with important lines of war work. A number of the members of the technical staff of this bureau were given commissions in different branches of the Army and assigned to work along the lines of their qualifications. Assistance was given the Sanitary Corps in a number of ways, particularly in analytical work necessary in nutrition surveys at Army camps.



THE BUREAU OF SOILS

The Bureau of Soils actively aided in the work of carrying on the war in two ways -- by supplying the War Department with maps and other information needed in map construction, and by cooperating with that department in factory scale experiments on fixation of atmosphere nitrogen at the Arlington laboratories.

When war with Germany was declared, there was a strong demand for definite cartographic information, especially of that part of the country lying along the eastern and southern coast. The United States Geological Survey, having been engaged primarily in the mapping of the mineralized regions of the country, had devoted its attention, in the main, to the rougher mountainous parts, and had left the work of surveying much of the smooth, agricultural lands of this coast section to the future. It therefore happened that the maps constructed by the Bureau of Soils, though they do not show the topography, were the best extant. These maps were in great demand by various bureaus of the War Department. Copies of all published maps were called for and in many cases advance information concerning areas, the maps of which had not been published, was supplied. Information concerning the soil of certain localities was also furnished the War Department, though much greater use could have been made of the accumulated data in possession of the bureau particularly in the locating of camps and cantonments.

Drawing Nitrogen from the Air

The work on fixation of atmospheric nitrogen was carried on actively in cooperation with the Bureau of Ordnance of the War Department. An

installation of equipment for producing synthetic ammonia was successfully operated, and many problems connected with the fixing of nitrogen from the air were solved. The work was highly valuable to the War Department and the Government was fortunate in having a factory scale laboratory equipped for the purpose. The results would have assumed much greater importance had the war continued into the present year, but they will not be without value in connection with the operation of the Government nitrate plant in time of peace.

When the United States entered the war, the Division of Fertilizer Resources in this bureau had at Arlington a Haber synthetic ammonia apparatus well along toward successful operation. With the entry of the United States into the war, synthetic ammonia became immediately more important as a product for munitions than as a product for fertilizers. Accordingly, the bureau at once got in touch with the War Department and entered into cooperative arrangements by which the work could be prosecuted much more rapidly by the use of additional funds, and chemists secured through the selective draft, than could have been done with the limited funds at the disposal of this bureau. As a result of this cooperation, the plant was pushed to completion and synthetic ammonia was produced, demonstrating the practicability of fixing atmospheric nitrogen in this way under American conditions.

In the meantime, the War Department had erected at Sheffield, Ala., a plant designated to produce, by a modified Haber process, 20,000 tons of ammonium nitrate a year. Difficulties were encountered in the successful operation of this large plant. During the summer of 1918, the Bureau of Soils and the War Department entered into an agreement by which the Arlington plant of this bureau was to be used under a cooperative arrangement between

the Bureau of Ordnance and the Bureau of Soils as a testing plant for working out, on a small scale, some of the numerous problems which had arisen in connection with the operation of the larger plant. Since that time, the plant at Arlington has been run continuously with these objects specifically in view and is operated night and day in the effort to work out experimentally some of the problems which make it impracticable to operate the large plant as it now stands.

THE BUREAU OF CROP ESTIMATES

The Bureau of Crop Estimates of the Department of Agriculture was largely relied upon as the statistical authority in connection with the tremendous campaigns of food production and food control and conservation that contributed so materially to the winning of the war. Not only did it assist the other bureaus of the Department of Agriculture in carrying out the food production program and related projects, but its services were used by the other departments and by the specially created agencies of the government, notable among them being the Food Administration, the War Trade Board, the War Industries Board, the Military Intelligence Office of the War Department, the Council of National Defense, the Federal Trade Commission, and the Tariff Commission.

Two days before the declaration of a state of war, the Bureau of Crop Estimates had started a seed supply inquiry with the purpose of locating areas of excess and deficient seed supply, in order to facilitate exchanges as a step toward making sure that the increased acreage program would not fail in any section for lack of necessary seed. Four days after the declaration of the existence of a state of war, there was launched an agricultural workers' inquiry, to ascertain the percentage of farm work done monthly, the number of extra workers ordinarily used each month of the year, and the supply of hired labor at that time as compared with usual. Inside the next week, at the request of the Council of National Defense, an emergency

crop schedule was begun, to show the probable acreage of various crops compared with 1916 and the usual, the intention of farmers regarding the 1917 crop, and the general farm outlook. Fertilizer schedules were undertaken in June, and, in July, a winter wheat inquiry, to show conditions at harvest, percentage of acreage harvested, and the indicated yield per acre.

During August, special inquiries and schedules were made to investigate reports of abnormal slaughter of milch cows, to determine the financial condition of farmers looking to fall planting, to ascertain food stocks on the farms, this being repeated in December, and to determine the probable acreage to be devoted to wheat in 1918 together with seed requirements for it.

Stimulating Grain Production

In January, 1918, inquiries were made to ascertain the conditions of winter wheat and the probable acreage to be abandoned, and to locate surpluses of sound seed corn from which deficient areas could be supplied. A special farm labor inquiry was made in February, to determine supply and demand. In March, an emergency live stock inquiry was made, to show the probable number of cattle to be fed and the number to be grazed during the succeeding summer and winter, and the probability of feeding more swine than usual the succeeding winter. Another emergency inquiry that month was to ascertain, from present conditions and intentions of farmers, the probable acreage to be devoted to various food crops in 1918. This was followed in May by a special inquiry to determine shift in acreages due to war conditions and percentages of total acreage devoted to various crops. Another seed corn inquiry was conducted in May to determine the quality of the seed, percentage tested, per cent of germination and rate of seeding per acre. Three special inquiries were conducted in June, two of them applying to fertilizers

and the other to determine the binder twine requirements of the country.

In July, an emergency live stock survey was made to determine the number on farms. In August, a special inquiry was made for the Food Administration to determine the uses made of the wheat crop. The last special inquiry made before the signing of the armistice was in October and was to determine the quantity of various crops fed to live stock each month. Since the signing of the armistice, there have been made, - another live stock survey, an inquiry to determine the amount of commercial fertilizer and manure used for various crops, and a census of the location and type of farm tractors.

The truck crop reporting service, owing to war demands for more information of food production, was extended. A weekly Truck Crop News was published. A paid reporting service, to insure regularity of information from truck growing regions, was organized. This service, however, had not reached full development when the armistice was signed.

Field agents and crop reporters in the drought-stricken areas assisted in making the Government seed grain loans in the fall of 1913.

Crop Statistics Gave Great Service

The Crop Recording and Abstracting Service furnished, for war purposes, agricultural statistics for the United States and foreign countries showing acreage, production, supplies, prices on farms and at markets, wages, number and value of live stock, exports and imports. Statements were prepared for the War Trade Board and for the confidential use of American representatives abroad, giving production of crops in 1913 in each of the small political divisions of Germany, Austria Hungary, Bulgaria, Roumania, Serbia, Greece and Russia.

The field forces of the bureau cooperated with various war agencies. From the beginning of the war, the field agents served, in a sense, as secret agents, reporting to the nearest United States Marshal any evidences of disloyalty, and, upon request of a United States Marshal, assisted in investigating charges of disloyalty. At the request of the Alien Property Custodian, the crop reporters reported to him property known to be held by aliens.

The library of this bureau was very largely used by representatives of the various war agencies. The number of persons using the library daily during the war showed an increase of 300 percent over the number using it prior to that time.

THE BUREAU OF ENTOMOLOGY

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From the beginning of the war, the Bureau of Entomology was able to be of service to the country, and especially to the military forces in many ways. The damage to stored grain and to grain in shipment soon came to the front. Enormous quantities of grain and other materials were accumulated at the port of New York for shipment to Europe. The immense warehouses at the Bush Terminal in Brooklyn were centers of accumulation of such material. The Bureau of Entomology was called upon for advice by the War Department, and a laboratory was stationed at this terminal where men experienced in the study of insect pests of this character were stationed, where competent inspection was made, and where arrangements were made for the proper fumigation or other treatment of stored products found to be infested with insects.

Experts on the Pacific Coast and in the South were engaged in the inspection of many warehouses and mills where food supplies were stored and, throughout the entire period, large supplies of food that were being seriously affected by insects were located. The owners of such supplies were advised of the necessity of prompt action in order to avoid further losses, and were shown how to prevent losses in newly acquired supplies that were free from insects.

The same sort of work was done in regard to insects affecting lumber and stored wooden implements. Early in 1917, a conference was held with representatives of the branches of the War and Navy Departments, Shipping Board, etc., which were responsible for the supplies drawn from

the forest resources of the country. The object of this conference was to offer the services of the entomologists and to explain how they could help, through special investigations and advice, toward preventing serious losses of forest resources and damage by wood and bark-boring beetles. Investigations of logging and manufacturing operations in Mississippi to meet the demand for ash oars, handles and other supplies required by the war service showed, for example, that one company had lost by ash-wood borer damage more than one million feet of ash logs through failure to provide for prompt utilization after the trees were cut. Serious losses to seasoned ash and other hard wood sap material from "powder post," it was pointed out, could be prevented through the adoption of certain methods of management by the manufacturers and shippers with little or no additional cost.

Protecting Airplane Wood from Insects

The urgent demand for spruce for the construction of airplanes led to an exceptional effort by the Spruce Production Board to utilize the great resources represented by the Sitka spruce of the Pacific Coast. It was soon realized that damage by wood-boring insects to the logs was a serious matter and that the advice of the expert entomologist was essential to prevent losses of the best material.

The problem was investigated by the entomologists and it was found that the prevention of the damage and loss was a matter of methods of management in the logging operations and prompt utilization during a short period in the year when the insects were abundant.

Early in the war and especially after the United States issued its declaration, the shortage of sugar made necessary an increase in the supply

of supplemental sweets, and, since none of these could be increased more economically and more promptly than honey, and since none of them has a higher value as food than honey, great efforts were made by the bee experts of the Bureau of Entomology to increase the honey production of the country. It was known that there was nectar available annually to provide for a profitable increase of ten or more times the then present honey crop, provided beekeepers were instructed in matters like proper wintering and disease control. All apicultural investigational work, except that on bee diseases, was discontinued and intensive extension work was begun. Specialists were sent out, held meeting, addressed more than 25,000 beekeepers, visited the apiaries, and gave personal instruction, with the result that the honey crop was greatly increased. American exports of honey to allied countries have increased at least ten times over those of any period previous to the war, and in the meantime the domestic consumption of honey has greatly increased.

During the period of the war, the Bureau of Entomology maintained a thorough cooperation with the Office of the Surgeon General of the Army in the matter of experimental work on insect problems. Under the National Research Council's Committee on Medicine, a sub-committee on medical entomology was established, of which the chief of the Bureau of Entomology was made chairman. Under this committee, an enormous amount of experimental work was done with the different health problems in which insects are concerned.

Bureau Deals Death to Cooties

For example, every suggestion that came to the War Department in regard to the control of the body-louse was referred to the entomological

committee, or to the Bureau of Entomology, and those which were promising were experimentally tested, either at Washington, Minneapolis, or, for a time, at New Orleans, where a branch laboratory was instituted. At the request of the Army War College and the medical department, as well as the chemical warfare service, tests were made of a new poisonous gas. This led to extensive experiments in cooperation with the Chemical Warfare Service leading to the possible utilization of gases used in warfare as fumigants for the control of insects and diseases. At the request of the Quartermaster's Corps, a complete investigation was made of all the details of the American process of laundering adopted by the Army, of the dry-cleaning processes and the hat-repair processes. In these investigations, the cooperation of the Bureau of Entomology with chemists of the Quartermaster's Corps resulted in the perfecting of the laundry processes so that it is now possible to guarantee the complete control of vermin in the laundry, if the laundering is carried out according to the methods recommended, which are very slightly different from those in common use. It was found that the laundry machinery gave ample means for any sterilization of clothing necessary. In the investigations of the dry-cleaning processes, it was found that the entire process gave complete control of vermin, but that gasoline treatment alone was not a perfect control. This discovery led to a long series of important studies of the effect of various densities of oils on insect eggs. At the request of the Chemical Warfare Service, various substances and impregnated clothes devised for the protection of soldiers against gas were tested as to their effects upon vermin. By a special request of the Electro-Therapeutic Branch of the Office of the Surgeon General of the Army, investigations were made of a high frequency generator as a control means against

the body louse, and as a result of these investigations suggestion was made as to the possible application of high frequency electric treatment for the control of scabies and other skin-infecting parasites. Cooperative investigations along this line are about to be taken up.

Among other problems investigated were the size of the meshes in mosquito bar necessary for the protection of cantonment buildings from disease-carrying mosquitoes; reports on the insects likely to be found injurious to troops sent to Siberia; investigations of the protective qualities against lice of furs dyed in various colors, and so on.

A series of lectures dealing with important sanitary problems from the insect side were mimeographed and were sent to persons in the Army, Navy, Public Health Service, and in civil life who were preparing themselves for or were actively engaged in sanitary entomology.

Entomologists in Army Service

Aside from this extensive cooperative research, entomologists were actually used in the Army, a number of them being given commissions while others acted as noncommissioned officers, assisting in the camp work on the control of insects that carry disease. The commissioning of expert entomologists for this kind of work was difficult, owing to the organization of the Army, but had the war continued, it is safe to say that more and more entomologists would have been employed in this important work, whether commissioned or not. The records made by a number of these men were admirable and met with well-merited praise in Army circles. In great concentration camps in several instances, entomologists were placed in entire charge of matters of mosquito and fly control, under medical command or under sanitary engineers.

In addition to this cooperation with the Army itself, the Bureau of Entomology cooperated with the Public Health Service, which had the extremely important work in charge of the health control of areas immediately surrounding the concentration camps, and held itself ready to assist in this work whenever called upon.

One of the earliest matters taken up by the Congress of the United States after the declaration of war in April, 1917, was the consideration of appropriations for the stimulation of crop production and in this consideration, naturally, one of the points was the control of the principal insect enemies of staple crops. Prior to any congressional action, however, the Bureau of Entomology started a country-wide reporting service on the conditions concerning these principal insect enemies, and engaged in excellent cooperation not only all of the State entomologists, the entomologists of all the agricultural experiment stations and the teachers of entomology in the colleges, but also the demonstration agents, the statistical agents, both State and Federal, the weather observers, and the field men of the Forest Service. The idea was to bring about as far as possible almost a census of insect damage and prospects, so that the earliest possible information should be gained as to any alarming increase in numbers of any given pest, that this information should be received at a common point, and distributed where it should be of the most good. The end sought was that repressive measures could be undertaken at the earliest possible moment in order to check the threatened loss. All reports received in this way were digested and distributed all through the growing seasons of 1917 and 1918 to the official entomologists of the country.

Soon after this service was instituted, the funds for food crop

stimulation became available and trained men were employed for demonstration work to act in connection with the Extension Service of the Department and of the different State colleges of agriculture. These men were assigned to different localities and took care of the demonstration work against the principal pests of staple crops all over the United States. Some of them were specialists on the insects which attack truck crops; others in those which damage field crops; others in those which affect orchards, and so on. Especial attention was given to the control of grasshoppers which damage grain and forage crops and to the sweet-potato weevil, an insect which bids fair to seriously affect the output of the South of this important vegetable.

Saving Crops from Insects

Aided, it is true, to a considerable extent by the winter of 1917-1918 which, from its unprecedented cold, had a destructive effect upon many important insect pests, and to a lesser extent by the character of the winter of 1916-1917, which also was a hard one for injurious insects, the economic entomologists, including the demonstrators, accomplished much. Owing to peculiar weather conditions in the early spring of 1917, certain insects not notably conspicuous before that time appeared in great abundance and added new problems to the production of certain crops. A notable example of such insects was the potato aphid, a species which previously had done almost no damage but which appeared in countless numbers throughout certain of the middle Western States in the early summer of that year. Notable work was done in the destruction of grasshoppers by the poisoned bait method, and it is safe to say that many hundreds of thousands of dollars, perhaps millions of dollars, worth of food crops were saved in this unusually intensive work. A single instance among many may be given in more

detail.

In the State of Kansas, the season of 1918 was remarkable for one of the worst grasshopper outbreaks that has occurred in that State since 1913. The danger was recognized during the fall of 1917, and a grasshopper-egg survey was instituted in cooperation between the State Agricultural College and the Bureau of Entomology. The results of this survey showed that, without doubt, a great hatching of grasshoppers was imminent, and extensive cooperative plans were immediately made. Winter meetings were held throughout many of the counties in the western one-third of the State, the farmers were organized and plans matured for the purpose of purchasing bran in large quantities. Prompt distribution of poison was made as soon as the grasshoppers began to hatch. In eight counties of the State, 36,000 pounds of white arsenic in 366 tons of wheat bran was used in the preparation of poison bait, which was distributed in an amount exceeding 900 tons. As a result of this general application of the bait, it appears that some 113,000 acres of wheat were saved from destruction. Estimating fourteen bushels per acre, which is considered a full crop in western Kansas, with wheat at two dollars per bushel, this represents a value of approximately \$3,000,000 saved in Kansas. This figure is considered conservative, according to the officials of the State Agricultural College.

In addition to the control work on grasshoppers affecting wheat fields, it is estimated that 25,000 pounds of poison bait was used throughout Kansas for the purpose of protecting alfalfa and sugar beets, and that 100,000 acres of alfalfa in western Kansas was saved by this application. With alfalfa selling at \$20 per ton, this represented \$2,500,000.

Insecticide Supply Important

All this control work was constantly in danger of being greatly hampered by the derangement of the insecticide situation in this country, due to war activities. Not only was the importation of arsenicals stopped, but their production was greatly limited by the fact that the smelters, from which arsenical compounds are gained as by-products, were so rushed in the production of urgently needed metal that by-product industries were largely stopped, and by the further fact that more than a third of the actual production under these limitations was, toward the end, used by the Chemical Warfare Service. Nevertheless, the entomologists and the chemists and the insecticide manufacturers held frequent conferences as to how best to utilize the reduced quantity of arsenical insecticides to insure the protection of crops to the greatest extent possible, and it resulted that, although the amount of arsenic available was really insufficient to meet normal demands, yet by conservative use and better distribution the requirements of the farmers, fruit-growers, gardeners and others were met.

There might be mentioned another side activity entirely due to war conditions. The extensive use of castor oil in airplane work made it necessary to grow the castor bean plant in great acreage in this country, since practically none was to be had elsewhere, the large Mexican crop having been bought up and sent to Spain, probably to secret German bases. Therefore, under Government contract, thousands of acres were planted to this crop in Florida and elsewhere. Though previously the castor-bean plant had not been known to be subject to serious insect attack, the planting of these large areas was immediately followed by the increase of certain injurious insects and by serious damage to the growing plants by the

southern army worm and other species. Entomologists were at once called in and, through rapid and able work much of the threatened damage was prevented.

While all this other intensive work was going on, the Federal entomologists were making a great fight in Texas by which the pink bollworm has apparently been absolutely wiped out in the districts in the United States infested last year. At the same time, there was developed a system by which damage done by the cotton boll weevil can be greatly reduced, which may be said to be the culmination of the work of many years.

THE BUREAU OF BIOLOGICAL SURVEY

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The killing of noxious and predatory animals, far removed as it may seem from military science, was a very potent factor in the successful prosecution of the war. The Bureau of Biological Survey of the Department of Agriculture, in carrying on this work, not only increased food production and decreased food waste to a very considerable extent, but contributed largely to the comfort and fighting morale of the soldiers and sailors.

One of the most uncomfortable things for a soldier on duty in the trenches, or in camp, is rats. Not only do they pollute his food where they do not destroy it, but the mere sight and thought of the slinking, nasty beasts is enough to weaken any Army's morale. More than that, the rat carries with him, always, the spectre of one of humanity's most deadly and loathsome diseases -- Bubonic plague. All during the European war, one of the most dreadful things in contemplation was that that plague might break out in the trenches and devastate Europe again as it did in the Middle Ages.

When the United States became a party to the war, the Bureau of Biological Survey had on its staff several men who were literally "death on rats." They had spent a great part of their lives in the service of the Government studying the habits of animals, including rats, and specializing on methods of effectively destroying the harmful kinds on a large scale.

At the request of the Surgeon General's Office, one of them was commissioned as major, assigned to the Sanitary Corps, and sent to France to investigate the rat situation and to devise means for controlling it, to be on hand, if the plague should appear in the trenches, prepared promptly to

prevent its spread. Five other experts of the Bureau of Biological Survey, already in the Army, were detailed to assist him, and the six of them, attached to the Central Medical Laboratory of the American Expeditionary forces, remained on duty through the victory campaign and with the Army of Occupation.

Total Feasts for the Rats

They were not left alone at the front merely with the knowledge they had when they went over. In one of the buildings of the Department of Agriculture, there was a room in which the "two and seventy stinks" that Samuel Taylor Coleridge says he counted in Cologne, Germany, would have been confused and lost in the multiplicity of malodors. It was full of rats of many kinds, and biologists and chemists were catering to them, finding out just what kinds of food they liked best and just how a little of the most effective poisons could be best mixed with those foods. The results of these investigations were sent to the rat killers, along with various other information that might be useful.

But this was not more than a fair beginning of the rat control work done by the Bureau of Biological Survey for the Army and Navy.

Requests for advice and assistance were received from the officers in charge of six Naval stations, and from a still larger number of quartermaster officers in charge of Army warehouses and supply stations. These were inspected by experts of the bureau, and recommendations were made as to the most effective methods for destroying the rodents and for rat-proofing where practicable. Five hundred copies of Farmers' Bulletin No. 896, on house rats and mice, prepared by this bureau, were supplied the Quartermaster Corps and distributed to officers in charge of storage depots.

The results were so beneficial that requests were received from the Quartermaster Corps for the same number of additional copies of the bulletin to send to the quartermasters in charge of the military stores of the American Expeditionary forces abroad.

The following quotation from a letter by the officer in charge of the Bush Terminal warehouses, Brooklyn, indicates the value of this work:

"When the writer was placed in charge of Bush Terminal it was realized that as some of the warehouses were from 25 to 30 years old, and as wherever one opened a door to go into a warehouse he could hear the scurrying around of rats and mice and found signs of them on all sides, serious damage to subsistence supplies, such as flour, meal, corn, rice, oats, bacon, and even clothing, would result unless an intelligent campaign were inaugurated. The campaign was inaugurated at a time when the warehouses were practically empty, and continued steadily to date when the warehouses are 90 per cent full.

"The number of rats caught can not be accurately estimated, as the dead rats were dumped into kegs or garbage cans as caught, but in the estimation of the writer the number would be somewhere between 35,000 and 50,000 rats, and the damage done to Government stores by rats in thirteen months operation has not exceeded \$50 as an outside estimate.

"In the estimation of the Officer in Charge of Storage, the campaign against rats conducted under your advice and supervision has been entirely successful, and today the catch does not average a dozen rats a day, and nowhere in the warehouses is there a sign of the presence of rats in any quantity."

War on Animal Enemies to Food

The killing of predatory animals and of rodents other than rats, while not so directly connected with the Army in France, was not less effective in increasing and conserving the food supply for the Armies and civilian populations of the nations engaged in the war against Germany.

Each year predatory animals in the United States were killing more than \$20,000,000 worth of live stock. Outdoor rodents, also, were destroying not less than \$150,000,000 worth of cultivated crops and at least another \$150,000,000 worth of forage in the stock raising States every

year. On top of that, house rats and mice were known to destroy yearly about \$200,000,000 worth of food and other products on farms, at mills, in commercial storage houses, and elsewhere.

The need of an intensified campaign against predatory and other destructive mammals was obvious.

In its war campaign for the destruction of predatory animals and injurious rodents, the bureau concentrated its efforts about the stock-raising and farming centers, in order that the expenditures of funds available should produce the greatest possible saving of supplies. Cooperation with the State extension services and county agents, as well as with stockmen and farmers, was greatly enlarged. The work done by the bureau in these campaigns was so effective that, in addition to the temporary personal services of more than 100,000 cooperating farmers and stockmen, the States, counties, and individuals contributed funds amounting to more than \$800,000 during the calendar year 1918 for cooperative work, mainly under the immediate direction of this bureau.

The campaign to destroy predatory animals, such as wolves, coyotes, mountain lions, and bobcats, in Montana, Idaho, Washington, Oregon, California, Nevada, Utah, Wyoming, South Dakota, Colorado, Arizona, New Mexico, and Texas, resulted between April 1, 1917, and December 31, 1918, in the killing of 1,266 wolves, 46,235 coyotes, 171 mountain lions, and 5,852 wild cats through trapping and hunting, while extended poisoning killed tens of thousands of coyotes on important sheep ranches and lambing grounds, practically freeing many large range areas from losses of live stock through these pests.

The destruction of these stock-killing animals has meant a continuous saving for market of a great number of cattle, horses, sheep, goats, swine, and poultry, with a direct increase in the meat, hide, and wool output valued at not less than \$8,000,000.

Cooperation Given to States

In this work the bureau had the hearty cooperation of State councils of defense, State live-stock commissions, stockmen's associations, and individual stock growers.

Campaigns against native rodents, such as prairie-dogs, ground squirrels, pocket gophers, and jack rabbits, were mainly conducted in cooperation with the States Relations Service and the extension services of the agricultural colleges of North Dakota, Montana, Idaho, Oregon, Wyoming, Colorado, Utah, New Mexico, and Arizona, with the State and county commissioners of horticulture of California, the State Rabies Commission of Nevada, and the State councils of defense of New Mexico and Arizona.

More than 20,000,000 acres of agricultural and range lands were treated with poison baits to destroy these rodent pests, and reports show a saving during the crop season of 1918 of a total of more than \$13,500,000.

The cooperating States, counties, farmers, and stockmen's organizations expended, mainly under the direction of the bureau, more than \$750,000 during the fiscal year 1918.

With the beginning of the war, the bureau increased its educational campaign concerning the losses occasioned by house rats, the need for taking active steps to destroy them, and the need for protecting products from their depredations. Several States, notably Georgia, Alabama, Mississippi, and Indiana, cooperated in organized State-wide campaigns for rat destruction, and in addition there were many local campaigns in various parts of the country.

THE BUREAU OF PUBLIC ROADS

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When the United States became a party to the world war, faced with the necessity for rapid mobilization of men and materials, one of the serious limiting factors was the lack of improved roads adjacent to concentration points. Much military road building was immediately necessary. There was urgent need, in order to economize in man power, construction materials and money, that general road construction work the country over be suspended except in cases where the improvement would be of material aid to the military program. But, while it was necessary that work be suspended on many roads the improvement of which would have been, under ordinary circumstances, highly desirable, construction was equally necessary on many roads where, under peace conditions, it could have been deferred without hardship. The problem of what roads should be improved and where, in the general dearth, materials for such improvement were to be found was a serious one.

The three big road problems, then, were these: To build the necessary roads at and around cantonments and around concentration points for war materials; to improve such roads as were necessary to free movement from production points, and to curtail general road building to the end that labor, money, materials and machinery might be conserved.

The organization and experience of the Bureau of Public Roads in the United States Department of Agriculture were immediately directed toward meeting the military needs of the Government. Later, on the suggestion of the Secretary of Agriculture, the United States Highways Council was formed, coordinating the activities of the Department of Agriculture, the War Depart-

ment, the Director General of Railroads, the Fuel Administration, the War Industries Board, the Employment Service of the Department of Labor, and the Capitol Issues Committee. These two agencies -- the Bureau of Public Roads and the United States Highways Council -- were charged with the carrying out of the Government's policy of road building during the period of the war. The two worked in close cooperation, the chief of the Bureau of Public Roads serving as chairman of the Highways Council. In all of the work of both of these agencies, close cooperation was maintained with the State Highways Departments.

Roadways Rushed to Cantonments

The first big war task undertaken directly by the Bureau of Public Roads was the construction of necessary roadways in the sixteen National Army cantonments and in one guard mobilization camp. The total construction planned and carried out in these camps aggregated several hundred miles and included practically all of the common types of construction from sand clay to concrete roads.

Eighteen engineers were detailed by the Bureau of Public Roads for periods ranging from three months to more than a year, to prepare plans and superintend the construction of roads at the following camps:

- Camp Devens, Ayer, Massachusetts.
- Camp Upton, Yaphank, Long Island.
- Camp Dix, Wrightstown, New Jersey.
- Camp Meade, Admiral, Maryland.
- Camp Lee, Petersburg, Virginia.
- Camp Jackson, Columbia, South Carolina.
- Camp Gordon, Chamblee, Georgia.
- Camp Sherman, Chillicothe, Ohio.
- Camp Taylor, Louisville, Kentucky.
- Camp Custer, Battle Creek, Michigan.
- Camp Grant, Rockford, Illinois.
- Camp Pike, Little Rock, Arkansas.
- Camp Dodge, Des Moines, Iowa.
- Camp Funston, Fort Riley, Kansas.
- Camp Travers, San Antonio, Texas.
- Camp Lewis, American Lake, Washington.
- Camp McClellan, Aniston, Alabama.

Besides the necessary roads in and around the camps, it was necessary in most cases to construct or rebuild suitable roads from the camps to the cities on which they depended for supplies and equipment. Such roads were constructed under the direction of the Bureau of Public Roads and in cooperation with the State Highways Departments under the Federal-Aid Road Act, as follows: Alexandria, Louisiana, to Camp Beauregard; Little Rock, Ark. to Camp Pike; Columbia, S. C., to Camp Jackson; Spartanburg, South Carolina, to Camp Wadsworth; Greenville, S. C., to Camp Sevier; and Aniston, Ala. to Camp McClellan. Engineering assistance was given in the construction of roads from Alexandria, Va., to Camp Humphreys and from Petersburg, Va., to Camp Lee.

Road Bureau Aids Shipbuilders

In both the shipbuilding program and the war emergency housing program, the assistance of the Bureau of Public Roads was required. One highway engineer was detailed to assist the Emergency Fleet Corporation in planning roads and streets in connection with shipyard developments. He gave his entire time to this work from March 5, 1918, until after the signing of the armistice. Another engineer was loaned to the United States Housing Corporation as consulting engineer on roads and streets necessary in connection with housing developments.

The mapping of roads was not less necessary to the military program than the construction of roads. The Bureau of Public Roads made complete and detailed highway maps, utilizing as far as practicable the topographical sheets of the United States Geological Survey, covering all of Maryland east of the meridian passing through Washington, all of the coast counties of New Jersey and all of Florida south of Jacksonville. These maps were made for the use of the Engineering Corps of the Army.

In addition to these detailed highway maps, the principal highways in a zone extending from Boston to Newport News through New York and Washington were plotted on topographical sheets for the use of the Geological Survey in the preparation of aeroplane maps.

Detailed route maps were prepared, covering Army truck route from Detroit to Baltimore, the work being done in cooperation with the United States Geological Survey and the Engineering Corps of the Army.

Cooperation was maintained with the Shipping Board in other ways than the building of roads. In designing reenforced concrete ships, the Bureau of Public Roads was called on to make several series of tests in order to obtain information necessary to insure the safety of concrete ship designs.

Concrete ship construction was substantially a new thing. It was uncertain whether the steel used for reenforcing was protected by the concrete against the action of salt water. To determine this point, the Bureau of Public Roads made tests with bars protected with various kinds of paint coatings and metal coatings, both to determine the protection afforded and the effect of the coatings on the bond strength.

Another question that had to be determined in connection with concrete ship building was that of "shear stresses." The term means, in mechanical language, a strain or change of shape of an elastic body resulting from applied forces which cause or tend to cause two contiguous parts of the body to slide relatively to each other and in a direction parallel to the plane of contact. In the design of a concrete ship the shear stresses are very high and, in order to use as little steel and concrete as possible, it was necessary to use much more unit stress in shear than in the ordinary reenforced concrete construction. No test results were available to indicate what would be a safe unit stress

with the exceedingly rich mixture of concrete used in ships. It was necessary, therefore, to make a number of beam tests to determine this point. This work was done by the Bureau of Public Roads.

Show How to Pour Concrete Ships

Still another point in connection with the building of concrete ships worked out by the Bureau of Public Roads was that of a satisfactory pouring method for concrete. Because of the extremely thin walls containing a large part of the reenforcing steel, it was necessary to pour the concrete so that it would entirely surround the steel in such a way as to form smooth surfaces and yet to be of dry enough consistency to produce the densest possible concrete. A specimen resembling the shell of a concrete vessel was made up and the concrete was poured into it, after which the form was rapidly vibrated by hammering the sides. The first method of pouring tried out by the Bureau of Public Roads was a complete success, and no further experiments were necessary.

Assistance was given to the Bureau of Standards in pouring concrete into a large design to resemble a concrete bulkhead for use in constructing watertight compartments in steel vessels. During the pouring, measurements were taken of the pressure exerted by the concrete against the forms, using the soil pressure sills designed by the Bureau of Public Roads.

In concrete ship construction, there are many places where the concrete can not be poured continuously and it becomes necessary to join, with as strong a bond as possible, the newly poured soft concrete to the hardened surfaces. The Bureau of Public Roads worked out and tested a number of different methods for accomplishing this.

In connection with tests made for the Shipping Board at its laboratories, it was necessary to have instruments that would register exceedingly minute

changes in length. At the request of the Shipping Board, the Bureau of Public Roads constructed such test instruments.

Considerable work was done by the Bureau of Public Roads in the testing of high explosives. At the request of the Frankfort Arsenal, Philadelphia, a device was worked out for testing the power of explosives with the idea of obtaining an autographic record of the force and speed. The bureau's impact machine was borrowed by the American University for research work in connection with high explosives. Impact machines of the type employed by the bureau are now used in practically all of the arsenals throughout the country in their routine investigations of explosive materials.

During the first fourteen months of participation of this country in the world war, the Bureau of Public Roads worked independently of any interdepartmental agency. The United States Highways Council was not formed until June 8, 1918. A short time prior to that date, the Secretary of Agriculture suggested the formation of such a council and asked that appointments to it be made by the Secretary of War, the Director General of Railroads, the Fuel Administrator, and the Chairman of the War Industries Board, these representatives to serve jointly in handling street and highway problems during the period of the war. Such representatives were appointed and organized on June 8 by electing as chairman of the council the chief of the Bureau of Public Roads.

Highways Council Averts Delays

The council was formed primarily to prevent the long delays, financial losses and uncertainty incident to the method of taking up each highway problem in its turn with the separate Government agencies, and to utilize the organizations of 48 State Highway Departments with their trained personnel and knowledge of local conditions as a medium through which the highway needs of the

country were to be brought to the attention of the Federal Government. It provided a single agency in the nature of a clearing house where all highway projects calling for Government action could be considered and acted upon. It took cognizance of questions of finance, of materials, of transportation and of the necessity and desirability of a project.

At the time of the formation of the Highways Council, there were no indications of an early termination of the war. The Government was going forward with its plans for such a complete mobilization of resources as would be adequate for a war continuing through a period of years. In this program, a coordinated highways policy was of the highest importance.

The work was that of harmonizing and directing all Government efforts and interests to a common end. The War Department was interested in roads connecting cantonments and posts with cities and shipping points, in any through-highways over which government truck trains might be transported, and in any highways which might affect any of the numerous war activities of the Nation.

The Railroad Administration, controlling all of the rail transportation facilities, was in position to exercise a vital influence on the construction and upkeep of roads, as vast quantities of various road building materials were transported by rail. It was desirable to meet these transportation needs in a selective manner, so that urgent work might be done and less important work be postponed.

The Fuel Administration had charge of many materials that enter into road-building, including fluid oils, road oils, asphalts, and tars. Manufacturers delivered these for road-building materials only on permit issued by the Fuel Administration.

Other materials necessary for road building, such as cement, crushed stone, gravel, sand, structural and reenforcing steel, were controlled by the War Industries Board which had the power to establish priorities, allocate materials and fix prices.

The Capital Issues Committee was required to pass upon all road issues involving \$100,000 or more.

The Department of Agriculture, charged with administering the Federal-Aid Road Act and spending many millions of dollars a year in road construction, was the chief highways agency of the Government but was subjected under war conditions to the necessity of deferring to national needs that might be more pressing than those of road building.

Selecting Most Imperative Work

All of these agencies were brought together and coordinated in the United States Highways Council and, had the war continued for as long a period as was at that time generally expected, this council would have been an indispensable aid to the Nation's war program.

During the few months that it was operative, a great deal was accomplished. Starting out with the policy that all highway, street, culvert and bridge construction and maintenance projects should first be submitted for approval to the United States Highways Council through the appropriate State Highway Department, a system was evolved which secured the essential construction and held the non-essential at a minimum. Construction was favored by the council only when it was clearly established that maintenance was no longer possible except at prohibitive costs. Highways and streets of military value were placed first in order, then highways and streets of national economic value, then unfinished contracts involving obligations which could not be disturbed without serious consequences and, finally, streets and highways which, while

not of military or economic importance, were of such extreme local importance as to cause serious hardships if their construction were postponed. The State Highway Departments were requested to give most careful consideration to each application on its merits and to exercise the power of disapproval freely. The council itself considered only such projects as came to it with the approval of the State Highway Departments.

Pass on Projects Involving Millions

Applications for approval, including those which had been submitted to the Office of Public Roads prior to the establishment of the Council, reached a total of 7,307. A quantitative table dealing with the materials, transportation, and funds involved and showing such proportion as was definitely approved follows:

Item	Unit	Requested	Approved
*Capital issued	collars	\$49,538,075	\$ 7,334,821
Road oil	gallon	68,280,401	44,269,826
Tar	gallon	56,608,401	53,533,441
Asphalt	tons	190,207	159,475
Cement	bbls.	5,657,390	2,139,769
Brick	Ms.	109,125	52,239
Steel, structural	lbs.	10,663,250	694,820
Steel, reenforcing	lbs.	22,281,275	3,231,301
Crushed stone	tons	3,639,819	1,827,795
Gravel	tons	1,304,552	432,707
Sand and screenings	tons	2,216,481	982,479
Slag	tons	520,152	250,428
Corrugated iron culverts	lin. ft.	107,815	23,704
Piling Timber	lin. ft.	164,102	43,588
Pipe, Vit. Drain	lin. ft.	2,165,419	99,699
Pipe, cast iron drain	lin. ft.	47,052	43,740
Lumber	ft. (B.M.)	5,530,196	1,661,635
Granite Blocks	blocks	1,420,500	156,500
Miscellaneous	tons	123,206	49,513
Cars, open top	cars	55,059	26,361
Cars, box	cars	8,543	3,376
Cars, flat	cars	3,705	605

*Includes applications acted on by the Bureau of Public Roads prior to formal organization of the United States Highways Council, requested \$28,748,084, approved \$3,114,381. The Capital Issues Committee has jurisdiction and the Council served merely as an aid to the committee.

Diverting Resources for Greatest Needs

The approval of the Council obtained for highway purposes the equivalent of 99,000,000 gallons of road oils and tars and 159,475 tons of asphalts at a time when serious doubt existed as to whether any substantial amount of bituminous material could be made available for street and highway purposes. On other items, constructive help was given to highways in securing vast amounts of material which might otherwise have been difficult to obtain. No action by the Council restricted in the slightest degree the opportunities of shippers to obtain cars from local railroad companies. The requests, therefore, that came to the Council for cars were for constructive aid rather than for approval. Through the activities of the Council, more than 30,000 cars were obtained for highway purposes. This number constitutes a distinct net gain to highway needs over and above the supply which the local railroads were able to furnish of their own accord.

The restriction of highway work undoubtedly served to provide for the most worthy projects such materials as were available and to bring about on the part of States, cities and counties a much more thorough sifting of the various projects than would otherwise have been possible. Had the war continued, this conservative and selective consideration would have become more and more useful and necessary.

THE STATES RELATIONS SERVICE

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When the European war began, the United States had just entered upon the development of a comprehensive national system of extension work in agriculture and home economics. It involved not only the practical training of farmers and their families, but their organization for individual and community action in the improvement of agricultural practice and the economic and social conditions of rural homes and communities. It combined the scientific and investigational forces of the United States Department of Agriculture and the State agricultural colleges with the practical knowledge and experience of the multitude of farm men and women, organized to conduct demonstrations on their own farms and to take leadership in helpful movements in their own communities.

One of the most important and efficient features of the system is that commonly referred to as the county agent and home demonstration agent work. Its ultimate object, as embodied in the agricultural extension act, was to place in every agricultural county in the United States an agricultural expert, known as the county agent, to act as advisor and demonstrator to farmers, and a woman, known as the home demonstration agent, to act as expert advisor to the housewives in matters of domestic science and household economy. It is one of the most notable departures ever made in agriculture and has proved one of the most efficacious. It brings the accumulated knowledge of agricultural and domestic scientists directly to the farm families of the country in their fields and homes, and proves it in actual farm and household operations.

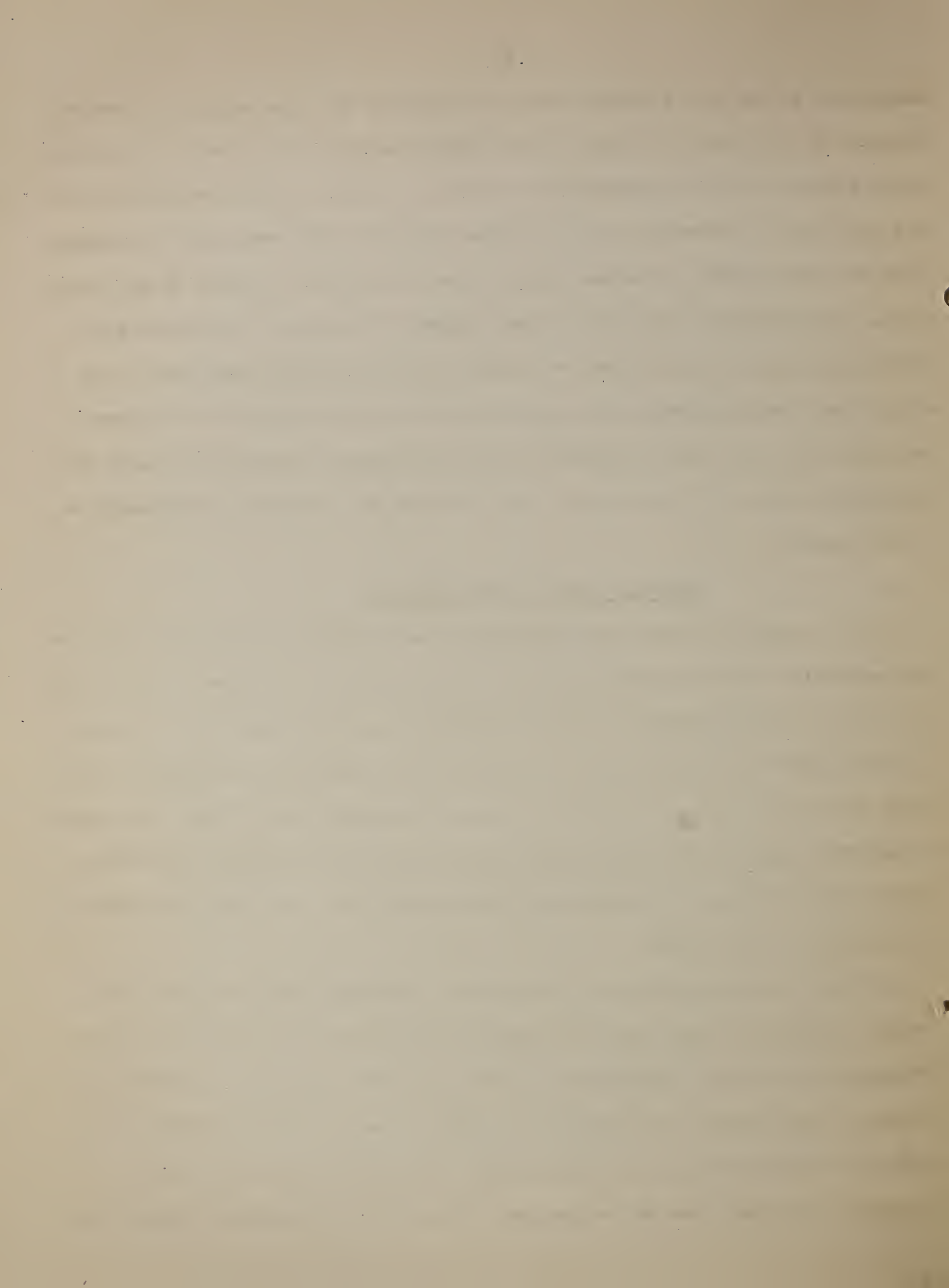
The entry of the United States into the war found the extension system partly organized in all of the States and in about half of the counties.

Immediately it was seen that both for the benefit of the farm people and for the promotion of the general welfare, it was highly desirable that every agricultural county should have this organization as soon as possible. It was evident that in this way both the Government and the people would have the best means of bringing about the agricultural production and the food conservation required by war conditions. The Government would also be kept informed regarding the attitude and needs of the farm people through the county and home demonstration agents, and could enlist their sympathy and support in such patriotic endeavors as liberty loan, Red Cross, and other campaigns by which information regarding war aims and requirements were to be disseminated and the means for successful prosecution of the war secured.

Swelling Army of Field Workers

The Secretary of Agriculture recommended and Congress provided means for the rapid expansion of the extension system, with the result that between July 1, 1917, and July 1, 1918, the number of counties with men agents increased from 1,434 to 2,435; the number of counties with women agents, from 537 to 1,715; and the total number of persons engaged in extension work, from 4,100 to over 7,000. The number of employees cooperatively employed by the Department of Agriculture, the State colleges of agriculture, and local and county authorities increased from 2,500 to 6,200 during the same period.

The first problem that these agents had to undertake was to organize the farmers, in order to reach them effectively and in order that the farmers might effectively solve their own problems. During the year the agents attempted to organize as many people as possible to undertake some type of work which would enable them to increase the food production, conserve the supply of fruits, vegetables, and meats, and to become more efficient in the phases of agricultural



production in which they were accustomed to engage.

In many cases, the county or home demonstration agents found in the counties in which they were placed some organization which indicated a demand for their services. The first activities of the agents in the counties were connected with the development of existing clubs or the organization of new farm bureaus, county councils of agriculture, or other associations to deal with rural life problems. All together, there were organized over 15,000 farmers' community clubs among men, 30,000 among women, and 50,000 among the boys and girls. The county agents during the year addressed over 250,000 gatherings and reached over 8,000,000 individuals. Through the work of the home demonstration agents, 6,000,000 women learned of the Government's desire for increased production and conservation, and 1,250,000 boys and girls were enrolled in the various lines of club activities.

Northern Workers Solve Corn Problem

One of the most serious problems confronting the extension agents in the Northern States during the war was the corn situation in many States in the spring of 1918. On account of early frost the preceding autumn, there was a large deficiency in corn fit for seed, while the war called for an increased production. It immediately became the function of the county agents to locate seed corn of high germination adaptable to the locality where it was to be planted, and to see to its proper distribution among the farmers. This problem called for organized effort. By intensive organization and the establishment of numerous testing stations, Iowa was able to care for its seed corn problem within the State, but Indiana, Illinois, and Ohio were forced to bring large quantities of seed corn from New Jersey, Pennsylvania, and Connecticut. The Seed Stock Committee of the Department of Agriculture assisted in the location

and distribution of this seed; and the county agents, both at the point of supply and at the point of distribution, aided in attending to the details of gathering the seed together and distributing it. The agents recorded that they made available to 326,662 farmers a sufficient supply of seed to plant 3,500,000 acres, and through their testing campaign 550,000 farmers tested their seed for germination, so that sufficient seed was provided to plant a total of 10,500,000 acres. In connection with their work to increase the production of corn, the agents influenced the farmers to increase their acreage of ensilage corn and thereby were able to increase the production of live stock.

The next crop of importance was wheat. The Department of Agriculture, in cooperation with the Food Administration, carefully determined the food needs, both at home and abroad, and suggested the needed acreage for each State. Within the States, intensive campaigns were carried on with the farmers, largely through the county agents, who not only kept the farmers informed as to what the needs of the country were, but assisted them in securing the proper supply of seed wheat and aided those farmers who had never grown wheat before in cultivation and harvesting. The activities of the agents aided in bringing about the planting of 4,100,000 additional acres, with an increased production of 45,000,000 bushels. A further additional 2,500,000 acres of winter wheat was planted in the fall of 1918 as a result of the wheat production campaign.

Another important feature of the work carried on by the county agents in the campaign for increased crop production was the treatment of oats for smut. Nearly 100,000 farmers, representing an oat acreage of 1,800,000 acres, were influenced to treat their seed oats. The agents also assisted the farmers in increasing their acreage of rye, barley, potatoes, buckwheat and other minor crops. Another important feature of their campaign was the establishment of

home and community gardens. They also encouraged, to a limited extent, the canning and drying of fruits and vegetables.

In the campaign conducted in 300 counties, the increased number of live stock involved was 128,000 head of cattle, 940,000 head of hogs, 382,000 head of sheep, and 1,050,000 fowls. Over 1,000,000 animals were treated as the result of the activities of the extension agents. The agents were able to bring about the introduction into these communities of a large number of purebred live stock, and took an active part in the campaign to increase the production of hogs.

Southern Workers Win Crop Diversity

The extension organizations in the South very efficiently met the problem of sustaining the production of food and feed in 1917 in the face of high-priced cotton. As a result of their very complete campaign, the acreage of cotton was actually reduced, and the acreage of corn, wheat, oats, hay, potatoes, sweet potatoes, and in fact all other crops, was increased. In the spring of 1918 the same thing was repeated except that the high price of cotton forced a slight increase in the cotton acreage. The acreage in corn was practically sustained, while the acreage of wheat, oats, rye, hay, potatoes, sweet potatoes, rice, peanuts, grain sorghums, velvet beans, and other food and feed crops was increased. In the fall of 1918, due to the campaign for more wheat, the seeding of wheat for the harvest of 1919 was increased.

The extension organization in the South conducted campaigns for an increased production of live stock, resulting in an increase of 6 per cent in the number of hogs, 3 per cent in the number of milch cows, 5 per cent in the number of sheep, and 5 per cent in the number of other cattle, the increase in hog production being the highest in Mississippi and Tennessee, each of ^{which} ~~which~~ shows a gain of 20 per cent over the year 1917.

The work among the men on the farm was primarily to encourage more abundant production. The campaign carried on among the women was not only for increased production but for conservation of those products which had formerly been wasted. In the South, where the work among the women had been carried on the longest, the reports of the agents indicate that 65,000,000 containers of vegetables, fruits, and fruit products, and 130,000 containers of meat and fish were put up, 9,000,000 pounds of dried vegetables and fruits stored, and 1,000,000 gallons of vegetables brined. In addition, 16,000,000 pounds of butter and 1,000,000 pounds of cottage cheese were made under the agents' direction.

The women agents carried the lesson of wheat, meat, sugar, and fat conservation to every family represented and reached so large a number of people that they materially assisted the Food Administration and other forces in putting many States and counties on a non-wheat basis during the spring of 1918. Six hundred and fifty-nine community demonstration kitchens were organized under their supervision and used for the purpose of community instruction. They organized and built 847 community canneries and 131 community drying centers. They assisted in the organization and establishment of 18 curb markets in cities where city women could buy direct from farmers and farm women fruits and vegetables brought in from the country. They organized 173 egg circles among farm women and girls, with the result that 575,593 dozen eggs were marketed cooperatively, 200,000 dozen eggs were sold through individuals belonging to these associations, and over 1,000,000 pounds of poultry were marketed. They secured the establishment of 137 rest rooms for women in towns.

Reach More than 3,000,000 Women

In the Northern and Western States, over 3,000,000 women were reached through training classes, talks, demonstrations, and visits to homes, and interested in various phases of food production, utilization and preservation, the conservation of clothing and fuel, and various phases of health and child care.

Under the immediate supervision of the agents, 140,000 gardens were grown, 1,700,000 fowls were cared for, 4,000,000 pounds of butter, and 7,000,000 pounds of pork were produced, 110 community kitchens and 450 canning kitchens were established and 300,000 families influenced in food saving, 13,000,000 quarts of fruit and 9,000,000 quarts of vegetables were canned, 2,000,000 quarts of vegetables brined, 270,000 pounds of meat and 50,000 pounds of fish canned, 350,000 pounds of fruit dried, and 805,000 pounds of vegetables and 500,000 dozen eggs preserved.

Not only the adults, but the boys and girls as well, were interested in the problems of food production and conservation. All together, 1,250,000 boys and girls undertook definite work in the production and conservation of agricultural products under the agents' supervision. Some of the results that the boys and girls organized in club work reported in the North and West were the production of over 300,000 bushels of corn, 650,000 bushels of potatoes, 3,000,000 square rods of home gardens, canning of 3,500,000 quarts of vegetables, making of 350,000 jars of jelly, the production of 440,000 chickens, 170,000 dozen eggs, 900,000 pounds of beef, and 6,200,000 pounds of pork.

In the Southern States the boys' club work is handled by the county agents, while the girls' work recorded above is included in the work of the

home demonstration agents for women and girls. The boys' work in the South was responsible for the production of 528,950 bushels of corn, 40,000 bushels of peanuts, 30,000 bushels of potatoes, 6,338 bushels of grain sorghums, 12,857 bushels of wheat, 496 bushels of beans, 1,668,907 pounds of cotton, 224,517 pounds of beef, 1,728,092 pounds of pork sold for the market and 2,810,897 pounds of hogs retained for breeding purposes. The poultry work is reported under the girls' work. The total market value of products of the boys' clubs in the South was \$11,803,385.32. These boys borrowed from banks \$536,402 for the purchase of animals to engage in club work.

Both the home demonstration agents and the county agents encouraged the planting of war gardens, and never before had the farmers been able to supply their food needs so adequately from home gardens. In addition, the county agents were very influential in establishing local labor exchanges, which enabled the farmers readily to find such help as was available in the community in case of need.

Taking the Message to the Family

The achievements indicated above were the results of the direct contact of the agent with the farmer or a member of his family. Although there were many agencies at work influencing the farmer, probably none reached him as effectively and as quickly as the Department of Agriculture and the State colleges of agriculture did through the county agent and home demonstration agent. Although the labor supply available to the farmer was considerably decreased, where his sons and hired men went into the Army and his daughters went into the war industries, he increased his total acreage in crops from 333,000,000 in 1916 to 334,000,000 in 1917, and to 355,000,000 in 1918. The number of milch cows was increased from 22,895,000 in 1917 to 23,470,000 in

1919, the number of other cattle from 41,690,000 to 44,400,000, the number of swine from 67,500,000 to 76,000,600, and the number of sheep from 47,616,000 to 49,853,00.

As soon as the United States entered the war, the Office of Experiment Stations called specific attention to the questions which were of wartime importance and assisted in organizing cooperations among the stations for studying these problems. It also worked in close association with the agricultural department of the National Research Council. A register was prepared of agricultural specialists competent for experiment station work, which assisted the stations in keeping the ranks of their workers filled.

The work of the Office of Experiment Stations and the State institutions associated with it was not so evident from what they did during the war as in the accumulated results of their experimental and investigational work in the past. The results of their activities supplied information to the farmers and to the extension workers with reference to such subjects as making the most advantageous use of soil and cultivation, economizing the resources of water and soil, making the best use of available fertilizing material, combating disease and insect pests, practices to protect agricultural products against loss in transit and storage, the use of substitutes in food and feed, economizing human labor and making it more highly productive by making it more intelligent and resourceful, and in general giving man a larger ability to utilize the forces of nature, based on the knowledge obtained from investigational and research work.

The problem of the insular stations connected with the Office of Experiment Stations was to increase the food production on the islands and in Alaska. Before the war, the people served by the insular stations were large importers

of food products, the value of which reached \$30,000,000 annually. The use of many coastwise vessels for transport service to Europe reduced the available tonnage of food shipments and made it necessary for Alaska, Hawaii, Porto Rico, and Guam to make an effort to feed themselves. The efforts of the people under the guidance of the insular stations were highly successful and enabled them, in a large way, to solve their food problem.

What Was Done on Our Islands

To cite some typical examples, under ordinary conditions, Porto Rico was importing \$800,000 worth of beans annually, but, under the stimulus of war, it has been able not only to produce the entire amount for home consumption but a considerable surplus available for export. In the Tanana and Kantanuska Valleys in Alaska, the experiment station workers have been able to increase the production of potatoes, vegetables, and root crops in sufficient quantity to meet the local requirements of that section. In addition, the farmers produced 2,500 tons of food and forage for live stock.

Hawaii was accustomed to ship monthly 20,000 bunches of bananas. The removal of the steamers operating between Honolulu and San Francisco left the island with this supply of bananas on hand. It was found that one-third ripe banana pulp could be constituted for wheat flour in bread making. This practice was widely adopted, and the use of the banana and other substitutes decreased the importation of flour 51 per cent.

The war problems presented to the Office of Home Economics were to make special studies of war foods and diets and prepare numerous pamphlets, which were widely used in connection with the extension work as well as for general distribution by the department and the Food Administration. Attention was

paid to thrift in the use of clothing, household supplies, and household equipment. In cooperation with other bureaus, it made special studies in the use of dried fruits and vegetables, in the use of cottage cheese, and other matters relating to the food values and uses of milk, in order that proper use might be made of these available foods to take the place of wheat and fats desired for exportation to European countries. In connection with the Food Administration and the Bureau of Education of the Department of Interior, it published a series of leaflets for popular use in educating the public to the necessity for changing its diet to release wheat and fats. It also prepared a series of outlines for courses of instruction in food conservation designed for women college students interested in food conservation who were supposed to go back into their own communities as volunteer workers.

THE BUREAU OF MARKETS

The first thing that the Department of Agriculture had to consider during the war was the growing of more food, but there were two other tasks of scarcely less importance. One was seeing that food was properly distributed, and the other that food was not wasted. Nearly all the bureaus in the department had a part in these, just as they did in the production work, but there was one - the Bureau of Markets - whose organization naturally ran that way, and it was used more than any of the others in working out ways for better distribution and for putting the conservation doctrine into practice.

Some new projects were added, others were expanded. Technical investigations gave way, in large part, to the work of showing people how to do the needful things and actually helping to do them. Pains were taken to gather full information about food, food materials and feeds so that the work of distributing them could be handled intelligently and to find out just how much food could safely be used at home and how much could be spared. The work was done in cooperation with the Food Administration, the War Industries Board, the Quartermasters Corps of the Army, the purchasing officers of the Navy, Councils of National Defense and other Government agencies engaged in war work.

Four food and food materials surveys were made with the help of the States Relations Service and the Bureau of Crop Estimates. They showed the quantities of important foods that were in the hands of manufacturers and wholesale and retail dealers and in storage houses. Data were obtained

regarding the stocks of raw material on farms and foodstuffs in homes. The States Relations Service, in connection with the household consumption survey, assisted in making a special dietary study, the results of which were of importance not only during the war but promise to be permanently so. Through the assistance of the States Relations Service, reports were obtained direct from threshers in order to determine the production of the various cereals during 1918; from April 1, 1918, monthly reports were secured from elevators, mills, warehouses and wholesale dealers in grain and flour, on commercial stocks of grain and grain products, and similar reports from wholesale grocers and certain manufacturers covering sugar, condensed milk, canned goods and other articles. A monthly publication, "Food Surveys," has been issued since April, 1918, giving the results of these reports. Special issues gave in detail the results of three of the four general food surveys.

Cooperative Purchasing and Marketing

War conditions emphasized the importance of cooperative action in solving the purchasing and marketing problems of the growers of farm produce. Cooperative organization problems were discussed and suggestions given a large number of producers through conferences, farm bureau meetings, short courses, and similar gatherings. Personal assistance was given to many farmers in more than 30 States. Products included in these studies are fruits, vegetables, dairy products, potatoes, beans, cotton, hay, live stock, tobacco, nuts, honey, broom corn, and farm supplies. Where personal assistance could not be given suggestions were made by correspondence and served as guides to many communities in putting into operation plans for cooperative enterprises. A survey of cooperative enterprises in the United States was made and served not only as a distinct help during the war but is being continued under readjustment.

A very important line of work had to do with putting producers and city consumers in direct touch with each other. Demonstrations were made of the proper manner of preparing, packing and shipping farm products to facilitate sale direct to the consumer, and opportunities were found for marketing produce which otherwise would have been wasted.

An unprecedented impetus was given, as a result of the war, to motor transportation of farm products. Work began in March, 1918, and systematic effort has been made ever since to emphasize such phases as were of assistance in solving the rural transportation problems caused by the war. Detailed information was gathered regarding routes and items of cost. Supplementary reports were made for each route, showing operating conditions, business methods, facilities and general management, and all of this information was utilized in demonstrations. Detailed studies were made in a large number of districts looking toward the establishment of additional motor, freight and express lines. Eight demonstrational routes were started and have been successfully operated. Many new routes are in process of establishment, and requests for assistance are received from all sections of the country. Lists of motor trucks available during the peak of movement of farm products were filed in some of the large cities. Interest is growing in the marketing by motor truck of live stock from rural sections within a radius of 75 miles of stockyard centers. An investigator has been assigned to the Omaha section to study present methods, to stabilize the industry and to develop and extend routes into new territory.

In 1917 a special investigator began work in China, Japan, eastern Siberia and the Philippines, finding out the possibilities of marketing American fruits. This information was given Pacific Coast shippers for their

guidance during the fruit season of 1917-18. An arrangement was made with the Food Administration by which the technologist in charge of Grain Standardization Investigations of the Bureau of Markets went to Australia to investigate the condition of large quantities of grain which had accumulated because no ships were to be had to take it to Europe. Arrangements were made for the selection and inspection of grain intended for shipment to the United States.

In the autumn of 1918, a special investigator completed a study of the possibilities of marketing American fruit, live stock, meat, dairy products and wool in Australia, New Zealand and nearby islands. One of the results was that American grapes are now permitted entry. With the Bureau of Plant Industry and the Bureau of Animal Industry, the Bureau of Markets, in the winter of 1918, investigated conditions surrounding the marketing in Europe of live stock, meats, dairy products and seeds to determine the demands likely to be made upon America during reconstruction.

Opening up Foreign Markets

Throughout the war period, information as to conditions in foreign countries was collected. Statistics and current reports on all agricultural products were secured and tabulated in suitable form for use in current market reports. At several important ports, daily information was secured from steamship manifests regarding exports and imports of such perishable products as fruits, vegetables, meats, milk, butter and cheese.

Another important line of work had to do with the preservation of fruits and vegetables in transit and storage. Investigations had been conducted for several years, particularly as to the extent of deterioration caused by improper methods of harvesting, packing, storing and shipping. Extensive demonstrations were made to bring about the use of the information already obtained.

Growers and handlers were shown that decay and deterioration in transit can be reduced by more careful handling methods. Demonstrations were made to show that the efficiency of refrigerator cars could be increased by modifying the construction. Practically all of the refrigerator cars built for the past 18 months follow the designs recommended by the Department of Agriculture. The Railroad Administration has adopted this type of car as its standard of efficiency. Test shipments of fruits and vegetables showed that heavy loads properly ventilated maintained as low a temperature as light loads. The data obtained showed what is necessary for frost protection and, in cooperation with the Railroad Administration, methods were worked out for the construction of heater cars. Loading demonstrations resulted in the adoption by shippers and railroad officials of regulations to reduce losses. Many common fruit storage houses have been constructed or remodeled, and important improvements have been effected in the construction, ventilation and management of houses and cellars for potato storage, several hundred of which were built during the fall of 1918, in accordance with department recommendations.

Adapting Cotton to Airplanes

With the acute shortage of fats and oils that existed during the war, it became of the utmost importance that cotton seed and cottonseed products be fully utilized. Much work was done to lessen the enormous loss and waste in marketing cotton seed and cottonseed products, to secure more and better human and animal food and to release the transportation facilities required to haul useless foreign matter mixed with the seed.

One of the most spectacular pieces of work done by the Department of Agriculture directly toward the winning of the war, was the development of cotton fabric to be used as a substitute for linen in the making of airplane wings.



After the Germans took Riga, the Allies were almost completely deprived of raw material out of which to make airplane fabrics. From the beginning of flying machine development, it had been thought that linen was the only suitable material for making the wings, but in the vicissitudes of war, it came about that the enemy got possession of practically all of the flax in the world, the material from which linen is made. Ninety per cent of all the flax came from Russia, Courland and contiguous territory. After Russia went to pieces and particularly after the Germans closed the Gulf of Riga, it did not come, it either stayed where it was or went to Germany. Another 6 per cent of the world's output of flax was already in German possession in conquered Belgium so that for airplane and other needs the Allied nations had access to not more than 4 per cent of the output of flax. Unless a substitute could be secured, the Allied armies would very shortly have no "eyes in the air." That was in August, 1917. In its extremity, the Bureau of Aircraft Production called a conference of representatives of the Bureau of Standards of the Department of Commerce, the Signal Corps of the Army, and the Bureaus of Plant Industry and Markets of the Department of Agriculture. As a result of this conference, the Bureau of Markets undertook to make a cotton substitute for airplane linen. Tests were instituted to determine the possibility of using Sea-Island, American Egyptian and regular Egyptian cotton of the Sakellaridis variety. Experts of the Department of Agriculture took charge of some cotton mills that were turned over for the purpose and began making spinning tests. What they had to develop was a fabric possessing both the maximum of tensile strength and tearing strength with the minimum of elasticity. It was not long until they had made such a fabric, which was adopted as the international standard for airplanes.

Substitute for Balloon Silk

At the same time another line of investigations was carried out in an effort to find a substitute balloon fabric. The necessity for this was not so urgent as that for airplane fabric. Sufficient silk to make balloons could be obtained but it had to be brought from Japan and China which, owing to the shortage of ships and the submarine warfare waged by the Germans, was not an easy thing to do. Now an airplane fabric is one thing and a balloon fabric is quite another thing. An airplane fabric should have absolutely no elasticity. It must possess the highest possible measure of strength and resistance to tear, and it must be of extremely open weave. Nearly all the things that an airplane fabric must be, a balloon fabric must not be. Balloon fabric must be of exceedingly close weave, so close that, with a little rubberizing, gas can not get through it. These two dissimilar needs the cotton experts of the Department of Agriculture met out of the same materials. As a result of these investigations, between 50 and 60 of the largest fine-goods mills in the United States were engaged in the production of airplane and balloon fabrics. During the last few months of the war, the shortage of these fabrics was overcome and a reserve of several million yards was acquired.

Burlap was another material the commercial supply of which was practically wiped out by the war. The bulk of burlap sacks originally came from India. During the war, the British Government took practically the entire output for sand bags in the defensive works along the Western Front. The supply for export to the United States was reduced toward the vanishing point and prices went up accordingly. It was necessary to develop grain handling methods that would require fewer sacks.

Prior to 1917, practically all the grain in the States of Oregon,



Washington and Idaho was handled in sacks. The farmers, country shippers and dealers, as a rule, did not know how to handle grain in bulk. The Bureau of Markets sent to the Northwest men who were thoroughly familiar with bulk handling of grain. They advised the farmers how to handle grain from the threshing machine, how to construct portable and stationary farm granaries, how to obtain and operate bulk wagons, granary elevators and other equipment necessary for handling grain in bulk on the farm. They conferred with farmers' cooperative organizations, with line companies and with independent dealers about the management of bins, the construction and equipment of country elevators and similar matters. They assisted in the construction of a terminal elevator built by the municipality of Portland, Ore. This work produced desirable effects other than the saving of burlap sacks. During the war, most of the wheat grown in the Pacific Northwest came East instead of going to the Pacific Coast for milling or export as it had done prior to the war. The eastern markets handle grain in bulk and prefer not to receive it in sacks. The increased acreage planted to wheat as a result of war stimulation added to the necessity of providing additional handling and storage facilities to take care of the crop. The change in the system of handling Pacific Coast grain probably will be permanent.

Stopping Waste in Food Grains

It was necessary during the war to stop every possible waste of wheat and other food grains. One of the most serious elements of loss had always been fires from dust explosions in mills and elevators and at threshing machines. Millions of bushels of wheat had been destroyed every year in that way. A campaign was conducted by the Bureau of Chemistry, the Bureau of Markets, and the Bureau of Plant Industry for the prevention of such

losses. Investigations were made in all the principal wheat-producing sections. The department recommended the installation of suction flues to remove smut and grain dust, the installation of automatic fire extinguishers, and of a system to remove static electricity which was frequently the cause of the explosive mixture becoming ignited. A special educational campaign was made to show owners of mills and elevators and their workmen the conditions under which dust explosions and fires occur and the methods by which they may be prevented. A great many meetings were held. Information was presented by lectures, by lantern slides and motion pictures and by actual demonstrations of dust explosions. That work was begun in November, 1917. During 1918, not a single grain dust explosion of much consequence occurred in the whole country.

Many similar fires have occurred every year in cotton gins, causing tremendous losses. During 1918, a campaign was begun for the prevention of cotton gin explosions and fires. During the fall about 450 gins were visited and investigations made as to the causes of fires. Information was furnished to owners and operators, just as in the case of the mills and elevators, as to the proper operation of the gins in order to avoid explosions. This campaign was begun a year later than that of grain dust explosion, and has not progressed so far but methods are developing which will reduce the number of fires in cotton gins.

The several lines of market news service established shortly after the United States became a party to the world war, have proved among the most effective aids in facilitating the distribution of products by bringing the producers and the consumers in touch with each other.

The market news service on fruits and vegetables, established prior to the war, was greatly enlarged during the emergency. Daily reports are issued on 32 of the more important fruit and vegetable crops and distributed to all interested persons. They give carload shipments, the jobbing price in the principal markets, f.o.b. prices and other shipping-point information.

Over 10,000,000 Market Reports

Thirty-two market stations were in operation at the beginning of the fiscal year 1918 and 20 others were opened during the year.

During 1917, over 10,000,000 complete daily reports were issued from market field stations. The number of subscribers was about 90,000. During 1918, the number of reports issued increased to 23,000,000, and the number of subscribers to 120,000.

By special arrangements, reports have been received of local receipts and local market conditions in a number of cities not yet covered by the agents of the city market service. This information is published in daily or bi-daily reports for hotels, restaurants and stores. A special weekly review, showing the trend and fancies of the principal markets, is furnished to agricultural and trade papers. This review is based on the daily market reports of more than 500 carriers and is distributed to dealers, producers and other interested persons.

The market news service on live stock and meats had been established on a relatively small scale prior to the war and branch offices had been opened in several cities. Emergency funds made it possible to provide for large increases in the forces at these offices and to extend the leased wire service and to open offices in twelve other cities. Daily reports on meat trade conditions and a weekly review, showing the trend of meat movements and the

prices, are issued. The review is particularly interesting to wholesale merchants, live-stock dealers and commission men. During 1918, about 4,000,000 copies of the daily report and 700,000 copies of the weekly review were distributed.

Since July 1, 1917, daily telegraphic reports have been received from railroad division superintendents showing the number of cars of each class of live stock loaded west of the Allegheny mountains. On January 1, 1918, this service was extended to include the railroads throughout the United States. The reports show points of origin and destinations of all shipments. A monthly report from the officials of 81 stockyards shows the receipts for the shipment and slaughter of live stock. Fifty-two of these yards report the number of stockers and breeders driven out to feeding districts.

Information is collected showing the in and out movement of live stock in certain large feeding districts. This information is published weekly in "The Live Stock and Meat Trade News." Since June 1, 1918, all telegraphic market reports from Chicago Union Stockyards on live stock receipts and prices have been handled by the Bureau of Markets. This service is made available throughout the United States through the press associations.

War Produces New Market Services

The market news service on dairy and poultry products is purely an outgrowth of war conditions. The reports furnish a review of the dairy production of each State and the country as a whole. They have been used by various Governmental agencies, including the War Trade Board, the Shipping Board and the Fuel Administration, in determining policies relating to the conservation and market distribution of these products.

Daily market reports are issued from the Washington office and from

eight branch offices, furnishing information on prices, trade conditions, receipts, storage movement, and stocks in the hands of wholesalers and jobbers. Since July 1, 1918, these reports have included information on market prices of fluid milk and cream and condensed and evaporated milk, in addition to the wide range of manufactured dairy products previously included.

Another news service growing wholly out of war conditions is that of grain, hay and feeds. Branch offices are operated at New York, Richmond, Atlanta, Chicago, Minneapolis, Kansas City, Oklahoma City, Denver, Spokane and San Francisco, and from them are issued by-weekly reports containing statistical information on the stocks of hay, grain and feeds, the supply of and demand for them, and the prices at which they are being bought and sold in car-load lots. Weekly news letters are issued showing the supply, demand, prices and movement at all the principal markets. Special surveys have been made from time to time covering various phases of the work.

Thousands of cattle were saved from starvation in the districts where severe drought has occurred by the work of the emergency branch offices at Fort Worth, Tex., and Bismarck, N. Dak. The Fort Worth office was opened in December, 1917, and maintained for several months. Its surveys covered Texas, New Mexico and contiguous territory, the object being to assist in securing feedstuffs for the cattle raisers in the drought stricken areas. The Bismarck office was opened during the latter months of 1918 and rendered assistance in distributing hay and feed to the cattle men in the drought area of the Dakotas and Montana.

Surveys were made at the request of the Food Administration to determine the amount of feedstuffs in the north Atlantic States, and the supplies of

field peas in the Southeastern States. Another survey, made at the request of the Railroad Administration, furnished information on the location and quantity of soft corn of the 1917 crop as it became ready for shipment. This information was used by the Director General of railroads in distributing cars in such a way as to save this great quantity of feed from total loss.

Timely Information on Seed

When the war broke out, it became apparent that, if the food production was not to be hampered by shortages of seed in any section of the country, much greater effort would have to be made by the Department of Agriculture in giving special information to growers and dealers. A special reporting service, therefore, was organized, and a monthly publication was issued to give timely seed information. Field offices were established in Chicago, Minneapolis, San Francisco, Denver and Spokane. Vegetable, clover, and alfalfa surveys were made in November, 1917. Three subsequent seed and vegetable surveys were made. Through them, a comprehensive inventory was taken of the seed stocks of the country. Two special surveys of vegetable seed production were made. The information obtained was used in cooperation with the Department Seed Stocks Committee in seed stock distribution. Assistance was rendered in finding lots of wheat and rye in the Northwest, and judging their suitability for seed and in purchasing and distributing seed in the drought stricken areas in Montana and North Dakota. Information was furnished to the War Trade Board to assist it in shaping its policy for exportation and importation of seeds, and special assistance was given in providing for Canada's requirements of several seeds. Information obtained in connection with this service is published in "The Seed Reporter," and special reports are issued when emergencies arise that require special consideration.

Weekly seed corn reports were issued from Chicago, Minneapolis and Kansas City during the spring of 1918 when there was difficulty in finding enough sound seed corn.

The city market reporting service has had a marked tendency to reduce market gluts by increasing the consumption of abundant products. A consumer's report and a grower's report are issued. The former is made public through local newspapers, care being taken to avoid all technical expressions and to see that the reports may be helpful guides to the housewife in buying fresh fruits, vegetables, poultry, and other food. In some cases a "fair price" list is published. The growers' reports are distributed daily at farmers' markets or mailed to the farmers. In them, products in the market are grouped under heads showing whether the demand is active, moderate or poor. A brief discussion is made of market features and tables are furnished, showing whether the supplies of various products are light, moderate, liberal or heavy, the prices received by the growers and the prices received by the wholesalers and commission dealers, carload arrivals of certain products on the day of issue, and the total number of unbroken and broken cars on local tracks. Truck growers and less than carload shippers surrounding the larger markets are thus enabled to adapt their marketing procedure to conditions.

Reforms in Merchandising Methods

Careful studies are made of modern merchandising methods as they apply to food products, including stores that charge separately for goods delivered and charged and the "self serve" stores. The results of these studies have shown that, from the standpoint of consumers, producers and dealers alike, the handling of foodstuffs on large volume, quick turnovers and small unit profits is desirable. In this way it has been ascertained that the cost of food distri-

bution may be effectively reduced and spoilage and deterioration held to a minimum.

Throughout the period of the war, transportation conditions were such that the manufacturers, distributors and users of commodities in agricultural production had difficulty in obtaining cars. Many complaints and appeals for assistance were received from producers and distributors and all of them were referred to the Transportation Division of the Bureau of Markets. The bureau detailed transportation experts to heavy producing sections to work in close cooperation with producers and carriers in an effort to secure better service, to avoid shortages of cars and to secure refrigeration in transit by making the fullest utilization of equipment by heavier and ~~and~~ better loading.

Regulations regarding the distribution and cold storage of foodstuffs were formulated by the Bureau of Markets in cooperation with the Food Administration. Assistance was given to the Quartermasters Corps of the United States Army in planning better methods for the handling and cold storage of meat products intended for the Army abroad.

The Food Production Act authorized the Secretary of Agriculture to investigate and certify to shippers the condition of fruits and vegetables received at important central markets. To perform that function, the Food Products Inspection Service was instituted in the larger cities throughout the country. New markets were added from time to time. At present, inspection offices are maintained in 32 of the largest cities, and from these 14 additional markets are served.

By authority contained in the Agriculture Appropriation Bill, inspections can be made not only at the request of the shipper, as previously, but at the request of any party having a financial interest in the shipment, and certif-

icates can be made as to the quality and grade, as well as the condition of soundness. This work has resulted in the saving of a great deal of food which would otherwise have been lost. The inspection eliminates delays, brings about speedy adjustments and practically puts out of business the fly-by-night commission operator who formerly bought on a gamble and rejected shipments without cause if the price went down before the shipment arrived.

Inspection Service Aids Food Administration

The United States Food Administration made use of the Food Products Inspection Service of the Department of Agriculture. The surveys issued by the inspectors were commonly used as a basis of settlement of disputes between shippers and consumers and the adjudication of disputes with the Food Administration officials. Much work was done by the inspectors in collaboration with the subsistence officers at the various Army posts and cantonments. Inspectors at the various markets made a practice of visiting the Army camps located in their districts at regular intervals and made timely suggestions regarding the inspection of vegetables upon arrival at camp, the methods of storage, etc.

At the request of the Navy Department, the service was extended to cover the inspection of foodstuffs purchased for the Navy at New York and at the Great Lakes Naval Training Station. Prior to that time, the best dealers were not inclined to bid on Navy contracts because they could not compete with those who supplied products of inferior grade and condition. After the Inspection Service was put in force, large quantities of vegetables delivered to the transports were condemned and the actual receipts were confined to sound stock suitable to carry in the hold of the ship.

During the war period, standard grades for certain staple vegetables were worked out and recommended. The United States Food Administration made

these grades compulsory. They were also adapted by the Army as a basis on which to make all of its purchases. In this way the movement of a large crop was facilitated and market conditions generally made better.

The authority contained in the Food Production Act has greatly facilitated the work of the Department of Agriculture in securing good storage reports. These reports now include 44 commodities and are based on the information received from practically all of the cold-storage and meat-packing establishments in the United States.

The Government prices fixed for wheat are based upon the standards established by the Department of Agriculture, and these standards have been used in practically all sales of wheat since the beginning of the war. The elimination of competition by the establishing of a fixed price for 1917 wheat brought about entirely new conditions for the grain trade. The Federal wheat grades on which the prices were based had been made effective a very short time before, but the advisability of revising them to meet the changed conditions was considered. Suggestions as to the revision of the standards were invited from all grain interests. Twenty-two public hearings were held to secure, at first hand, the ideas of all branches of the grain trade. As a result, a revision of both the wheat and corn standards was promulgated by the Secretary of Agriculture and became effective on July 15, 1918.

Grading for Grain Corporation

Much inspection work has been done for zone agents of the grain corporation in determining the grades of samples. Cooperative work was done with the War Trade Board in the inspection of corn going to Canada. Such corn was shipped under license, accompanied by inspection surveys indicating the grade. This was done principally to protect the farmers of United States against

shortage of seed corn.

During the fall and winter of 1918, the grain corporation made large purchases of wheat based upon the Federal grades, and close cooperation was maintained by the Department of Agriculture. Intensive supervision was maintained on all deliveries. Many appeals on grades assigned have been entertained.

During November and December, appeals were checked involving an aggregate of 12,000,000 bushels of wheat. General supervision of wheat delivered to the corporation is constantly maintained.

It was found necessary to explain and demonstrate to country grain dealers, consumers and farmers, the application of the Federal grades. Some sections of the country had not been accustomed to the purchase and sale of grain by grades prior to that time.

Starting with July, 1918, a series of grain grading exhibits were made at the State fairs throughout the northern and western grain belts. During the summer and fall of 1917, grading schools were held in interior grain sections for the purpose of showing farmers and dealers how to inspect grain according to the standards. Representatives of the Bureau of Markets carried with them the necessary grain grading equipment and samples. Several State agricultural colleges that offered courses and lectures on the grading of farm products invited the bureau to make an inspection in connection with farmers' week or during the farmers' convention at the schools. Two such exhibits were made in January, 1919.

The shortage of nitrates for use in fertilizers appeared at the beginning of the war as one of the most serious limiting factors in increasing food crops production. As a step toward meeting that need, Congress appropriated



\$10,000,000 to be used as a revolving fund for the purchase of nitrate of soda to be sold to farmers at cost. By direction of the President, the War Industries Board handled the purchase of the nitrate and the Secretary of Agriculture its sale and distribution. The Bureau of Markets was the agency through which the work was done. About 120,000 short tons of nitrate was purchased and arrangements were made to secure, through the Shipping Board, tonnage sufficient to transport it from Chile to this country. Early in 1918, the price was established at \$75.50 a ton, f.o.b. the cars at the point of arrival. This price was announced in April, 1918. Applications were received totaling more than the quantity of nitrate purchased. These applications came from county agricultural agents and committees of business men appointed for the purpose.

Distributing Nitrate to Farmers

On account of the lack of available shipping facilities, it was possible to bring in only about 75,000 tons up to July, 1918. Practically all of this nitrate had been shipped to the farmers by that date. It early became evident that because of lack of vessels, sufficient nitrate could not arrive in time to make complete delivery during the period of greatest need. In order to make the quickest and most equitable disposition of such supplies as were received and to save the farmers the interest on the deposits required to be made in payment for it, there was appointed a distributor to whom shipments were made. This distributor apportioned the nitrate to the farmers of his county.

The distribution of the nitrate purchased from the War Department was undertaken in the spring of 1919. It is sold at \$81 a ton f.o.b. the shipping point.

On June 18, 1918, a proclamation was issued by the President requiring stockyards to secure licenses from the Secretary of Agriculture on or about July 25, 1918. On September 6, 1918, this proclamation was supplemented to include the stockyards' activities of slaughterers and renderers. The chief

The first part of the paper is devoted to a general discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The second part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The third part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The fourth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The fifth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The sixth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The seventh part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The eighth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The ninth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The tenth part of the paper is devoted to a detailed discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science.

of the Bureau of Markets was designated by the Secretary of Agriculture to administer the supervision of licensees under the proclamation. A force of market supervisors was organized and 30 men were stationed at central points, exercising effective supervision over more than 100 licensed stockyards. On January 1, 1919, 2,285 licenses had been issued to stockyards, live-stock commission concerns, traders, packers and renderers.

Complaints have been received from time to time concerning alleged violations of the regulations, and hearings have been held for the purpose of determining the issues involved. A number of complaints are now pending which involve questions of considerable moment to live stock interests and especially to live-stock producers. These complaints will be settled as soon as the necessary investigations and hearings have been completed.

The services of the supervisors in relieving congestion in large markets during the periods of heavy receipts, in improving weighing and yardage conditions, in expediting delivery service on belt line railroads and in numerous other directions have been highly commended by the patrons of these markets. The marked improvements effected and irregularities in market practices which have been corrected demonstrate the effectiveness of Government supervision over the live-stock markets and the consequent importance of adopting such supervision as a permanent measure.

THE DIVISION OF PUBLICATIONS

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Long before the entrance of the United States into the war, the Department of Agriculture was engaged in stimulating the production of farm products and the conservation of food stuffs. After this country got into the struggle, the department's activities were more intense and, when additional funds were granted, were greatly increased. This dissemination of useful and timely information in relation to agriculture is one of the two original functions of the department. Naturally, its efforts to influence food production and conservation largely found expression through its publications. It fell to the lot of the Division of Publications and the Office of Information to prepare and distribute the printed matter which should successfully appeal to the farmer for a determined effort to increase the farm output sufficiently to assure victory.

During the first three months of war- April, May, and June, 1917 - 200 publications, amounting to 7,385,000 copies were issued and distributed; during the year ending June 30, 1918, 1,200 publications were issued in excess of those issued during the year preceding, aggregating over 30,000,000 copies; and for the six months ending December 31, 1918, 31 additional publications appeared, of which there were 11,760,000 copies. In 21 months, a grand aggregate of nearly 1,450 emergency publications, amounting to practically 49,500,000 copies were edited, printed and distributed by the Division of Publications in addition to the usual work, as measured by prewar data.

From April 1, 1917, when the department inaugurated its campaign to

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increase the production of foods and to conserve the food supply of the country, to December 31, 1918, the Division of Publications used the stimulating-agriculture fund to edit, supervise the printing, and distribute emergency leaflets, circulars, bulletins, posters, folders, placards, etc., to the number of 49,429,283.

All of this printing was prepared specially to stimulate agriculture to help win the war and was in addition to the regular activities of the division.

During the war the division has had at its command from the regular and emergency appropriations about \$1,000,000 for printing and distributing information and suggestions, and with this sum about 200,000,000 copies of over 5,000 documents have been sent out in the intensive campaign to increase food production and to conserve the food supply.

Valuable Bulletins Help Win War

For emergency printing, to assist in this campaign, the department had special appropriations, aggregating about \$279,462. Some of the regular publications were utilized in the campaign. The following Farmers' Bulletins were used:

Farmers' Bulletins

- No. 824. How to Select Foods: III. Foods Rich in Protein.
- " 840. Farm Sheep Raising for Beginners.
- " 850. How to Make Cottage Cheese on the Farm.
- " 853. Home Canning of Fruits and Vegetables.
- " 871. Fresh Fruits and Vegetables as Conservers of other
Staple Foods.
- " 879. Home Storage of Vegetables.
- " 881. Preservation of Vegetables by Fermentation and
Salting.
- " 884. Saving Vegetable Seeds for the Home and Market Garden.
- " 900. Homemade Fruit Butters.
- " 915. How to Reduce Weevil Waste in Southern Corn.
- " 924. A simple Way to Increase Crop Yields.
- " 934. Home Gardening in the South.
- " 936. The City and Suburban Vegetable Garden.



- No. 937. The Farm Garden in the North.
- " 955. Use of Wheat Flour Substitutes in Baking.
- " 966. A simple Hog-Breeding Crate.
- " 987. Labor-saving practices in Haymaking.
- " 991. The Efficient Operation of Threshing Machines.

The titles of the emergency leaflets, pamphlets, circulars, folders, and posters issued are:

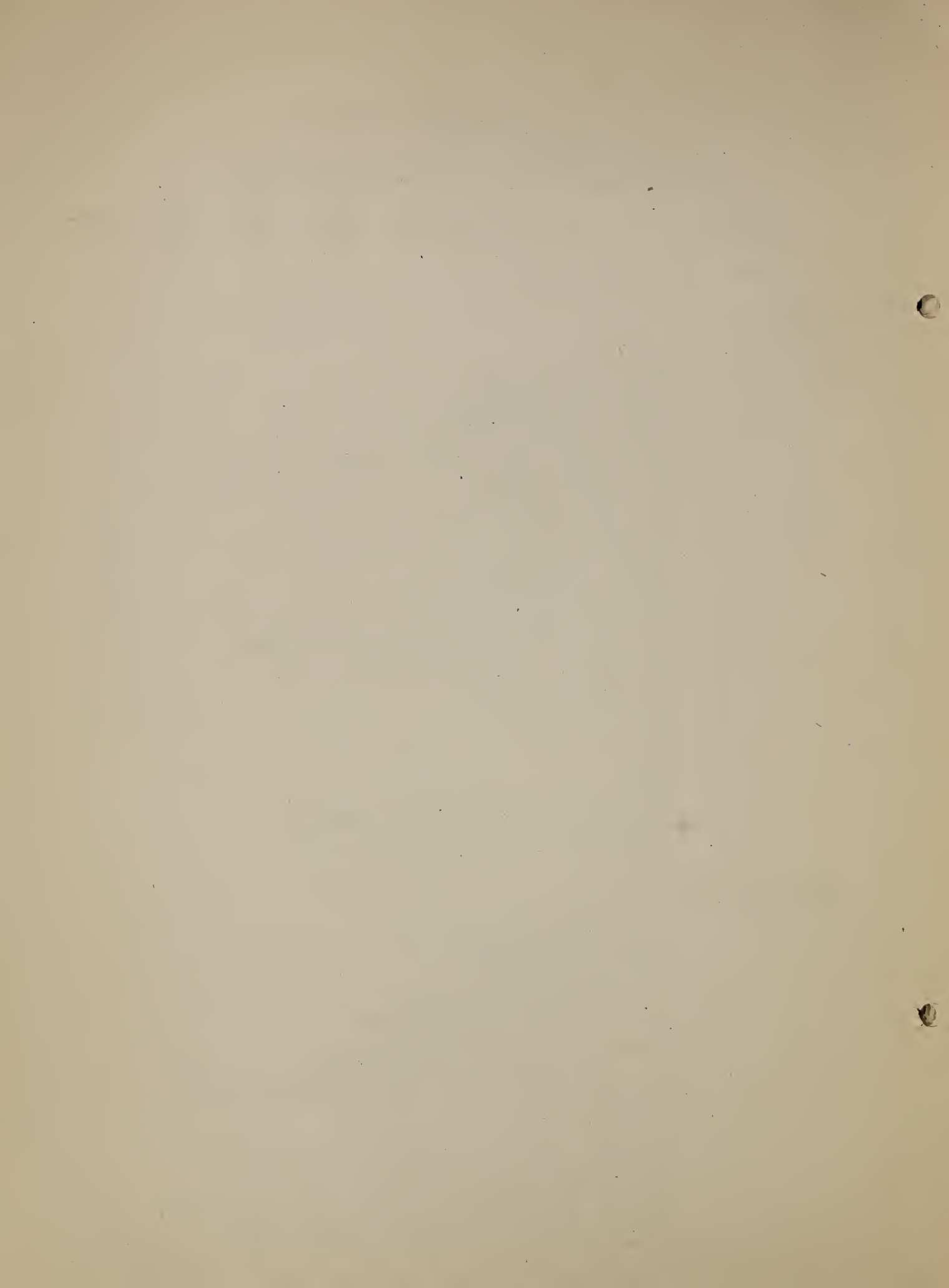
Leaflets

United States Food Leaflets:

1. Start the Day Right.
2. Do you know Corn Meal?
3. A Whole Dinner in One Dish.
4. Choose your Food Wisely.
5. Make a Little Meat go a Long Way.
6. Do you Know Oatmeal?
7. Food for your Children.
8. Instead of Meat.
9. Vegetables for Winter.
10. Plenty of Potatoes.
11. Milk the Best Food we Have.
12. Save Fuel when you Cook.
13. Let the Fireless Cooker Help you Conquer.
14. Save Sugar: Use other Sweets.
15. Dry Peas and Beans.
16. Fresh Vegetables.
17. Use More Fish.
18. Rice.
19. Hominy.
20. Wheatless Bread and Cakes.
21. Keeping Tab on the Poultry Business.
22. Library Leaflets, 4, 5, 6, 7.

Other Leaflets:

First Care of Baby Chicks.
Farm Labor Problems.
Five Little Pigs.
Pork Production in 1918.
The President to the Farmers.
Common Poultry Diseases.
Seeds and Plants for Home Garden.
Selection and Care of Poultry Breeding Stock.
Plant a Garden.
A Simple Trap Nest for Poultry.
Care and Feeding of Chicks.
How to Set a Hen and Care for Her.
Ways to Use Cottage Cheese.
Cottage Cheese, an Inexpensive Meat Substitute.
Some Directions for Making Cottage Cheese.



Use Potatoes to Save Wheat.
Chinch-Bug Leaflet.
Grasshopper Control.
Cutworm Leaflet.
Grasshoppers.
Turn Cold into Gold.
Skim Milk for Human Food.
Potato BlackHeart.
Home Canning of Meats and Sea Food.
The Cattle Tick and the War.
Spray Schedules for Apples.
Potato Beetles.
Spraying Potato Fields.
Garden Plant Lice.
Cabbage Worm.

Pamphlets: Movable Hog Houses.
 Apple Spraying Schedule, Southern States.
 Why we Went to War.
 Steps to Victory.
 A City Woman Who found her War Job on
 the Farm.
 The Business of Agriculture.
 Delicious Products of the Dairy.
 Ice: A Harvest Crop in Midwinter.

Circulars and Folders

Swine Production Should be Increased.
Preserving Eggs in Waterglass Solution and
 Limewater.
Safe Farming and What it Means for the South
 in 1918.
Back Yard Poultry Keeping.
American Standard Poultry.
Women on the Farm.
Control of Potato Leaf Spot.
Powdery Dry Rot of Potatoes.
Use Potatoes to Save Wheat.
Egg Circular for Southern States.
Cottage Cheese Dishes.
Saving Eggs is Public Service.
Use Barley, Save Wheat.
Use Peanut Meal to Save Wheat and Fat.
Use Soy Bean Meal to Save Wheat, Meat and Fat.
Selection and Treatment of Seed Potatoes to
 Avoid Diseases.
It is Possible to Prevent Grain Dust
 Explosions and Fires.
Put a Stop to Grain Dust Explosions and Fires
 in Threshing Machines.
Points for Poultry Packers.
Points for Egg Buyers.

Raise Chickens.
Supply the Farm Labor Need.
Formulas for Sugar-Saving Sirups.
Use Rice Flour to Save Wheat.
Cottage-Cheese Dishes.
Hatch Early.
A Method for Preparing a Commercial
Grade of Calcium Arsenate.
Use Peanut Flour to Save Wheat.
Use Soy-Bean Flour to Save Wheat, Meat, Fat.
Use Potatoes to Save Wheat.
Labor Saving in Live Stock Production.
Finding Labor to Harvest Food Crops.
More Poultry Needed.
Use Corn Meal and Corn Flour to Save Wheat.
Use Oats to Save Wheat.
Prevent Threshing-Machine Fires.

Posters

Raise More Poultry.
The Sweet Potato Weevil.
Have Eggs to Sell when Eggs are Scarce.
Raise Pigs and Help win the War.
Do not Sell Laying Hens.
Rats.
Cutworms.
Chinch Bug.
Turn Cold into Gold.
Fight Wheat Rust.
Potato Beetles.
Grasshoppers.
Garden Cutworms.
Save Seed for Victory.
Dust Explosions and Fires in Mills.
Spraying Potato Fields.
Garden Plant Lice.
Cabbage Worm.
Food is Going Up in Smoke.
The Country Needs You to Harvest Corn - The
Country Needs You to Harvest Cotton.
Raise More Poultry.
Apple Spraying Schedule, Southern States.
Spray Schedule for Apples, Northern States.
Make Every Egg Count.
Charts, Home Canning.
Saturdays too for Food Production.
Climax Basket Loading.
The Man Behind the Plow is the Man Behind the Gun.
Farming Problems in 1919.
More Money for Better Hides.
The European Corn Borer.
Join a Sheep Club.
Save Fuel in Dairy Plants.

Posters and Films Carry Messages

The Section of Illustrations' contribution toward winning the war consisted in the preparation of a number of posters designed to promote food production and conservation, and of several thousand lantern slides for the American Red Cross to be used in educational campaigns, the necessary material being furnished by that organization.

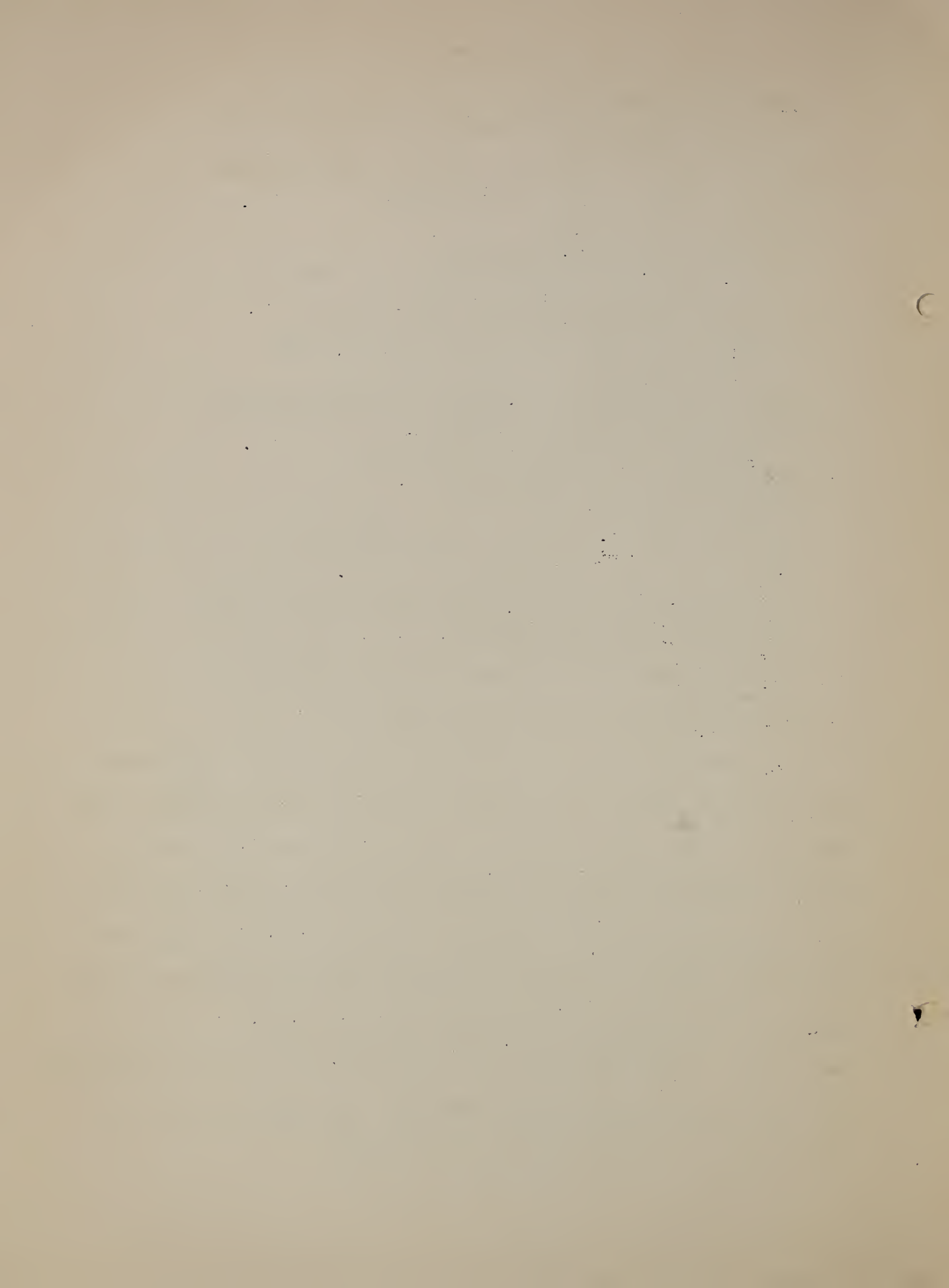
In the Motion Picture Section, films were produced to stimulate increased agricultural production and food conservation, and were exhibited in all parts of the country directly and through cooperation with the motion picture industry. In addition, special campaigns were conducted in motion picture theatres through the aid of slides, trailers, animated cartoons, and news pictures in film weeklies. Films were furnished, also, for use abroad.

For the dissemination of information by means of motion pictures which, before that time, had been conducted only on an experimental basis, Congress made an allotment which enabled the department to undertake the systematic development of this activity as a war measure. Films were given wide distribution in about 40 war emergency subjects as follows:

- Construction of ^a Concrete Silo; Construction on a Wooden Hoop Silo.
- Cooperative Cow Testing in Vermont.
- Lambs from Range to Market.
- From Wool to Cloth.
- Control of Hog Cholera.
- Government Poultry Farm, Beltsville, Maryland.
- Milk and Honey.
- Types of Horses at the Washington Horse Show.
- Uncle Sam's Pig Club Work.
- Why Eat Cottage Cheese.
- Bituminous Macadam Road Construction.
- Cement and Concrete Tests.
- Concrete Road Construction.
- Gravel Road Construction.

Macadam Road Construction.
Road Construction and Maintenance, and Road Tests with
Traction Dynamometer.
Testing Rock to Determine Its Value for Road Building.
Grazing Industry on the National Forests.
Lumbering Yellow Pine in the Southwest.
Lumbering Lodgepole Pine.
Lodgepole Pine for Railroad Ties.
National Forest as Recreation Grounds and "Bull Run" -
Portland's Water Supply.
The Wichita National Forest and Game Preserve.
The Work of a Forest Ranger, Tree Planting on the
National Forests.
What a Careless Hunter in the Woods Can Do.
Agricultural and Forest Resources of the United States.
Control of Pink Bollworm of Cotton.
Drying Fruits and Vegetables in the Home.
Dust Explosions (A technical reel).
Helping the Farmers of Tomorrow.
To Feed a Hungry World.
Cooperative Berry Growing in Pacific Northwest.
Cotton.
Poultry Pests and their Control.
Preventing the Spread of the Gipsy and Brown-tail Moths.
Congressional Seed Distribution.
Pythian Disease of Potatoes.
Strawberry Industry in Kentucky and Bridge Grafting to
Save Trees.
Work of the Forest Products Laboratory.

The equivalent of about 600 reels was shown in this country about 2,000 times, to about a million people, mainly by representatives of the department. They were exhibited at field and demonstration meetings, municipal gatherings, schools, churches, expositions, county and State fairs, and in motion picture theatres. In addition to this educational distribution, a large commercial film manufacturing and distributing company made releases in its screen magazines of abridgments of sixteen of these films. At least 30 copies of each of the films released commercially were distributed to motion picture theatres. They were shown at about 1,000 theatres to approximately 5,000,000 people.



Motion Picture Work Effective

The motion picture laboratory was used, also, by the Division of Films of the Committee on Public Information in conjunction with the force of this department for a period of about eight months. Nineteen reels of negative belonging to the Department of Agriculture were loaned to the Committee on Public Information for the making of prints for use in this country and abroad.

In the early months of the war, before their own laboratories were established, the Signal Corps and Medical Corps of the Army frequently made use of the motion picture laboratory and its equipment in the preparation of their films. In addition, the projection room of the laboratory was at all times at the disposal of the various War Boards and Foreign Missions.

The department supervised the exhibition of motion pictures of several other branches of the Government, in conjunction with its own; on six circuits of State fairs in twenty-three States, at which about 100,000 people were reached. Film was also made available for exhibition to the people of France and Russia and to the soldiers, sailors and marines of this country and of those nations associated with it.

Four major campaigns were conducted through motion picture theatres during the year as follows:

Eight thousand lantern slides dealing with the preservation of perishable fruits and vegetables were distributed for use in 2,000 motion picture theatres in the States of Massachusetts, Pennsylvania, New York and New Jersey, where reports received by the department indicated that there was danger of a loss of a large amount of such perishables.

The Forest Service conducted a forest fire prevention campaign, through motion pictures, in California, in cooperation with State agencies and a private film corporation.



Commercial motion picture weekly reels carried special pictures regarding the production of back-yard poultry, together with trailers urging that more poultry be raised as a war measure.

The largest campaign dealt with farm labor. The eight motion picture news weeklies carried news pictures, animated cartoons, and trailers from March until midsummer making appeals for the enlisting in farm work of people from the cities. Many other commercial films carried trailers on this subject. While it is impossible to measure the effect of these efforts, it is known that millions of people were reached and that, as a direct result, much farm labor was recruited.

THE OFFICE OF EXHIBITS

More than 13,000,000 people saw, during 1918, exhibits made wholly or in part by the Department of Agriculture and designed especially for the purpose of promoting greater production of farm crops, preventing food waste, to stimulate various activities toward winning the war and to develop the strongest feelings of loyalty.

One series of exhibits, covering more than thirty exhibitions and demonstrations, was planned and carried out wholly by the Department of Agriculture with the cooperation of fair and exposition associations. These exhibitions had to do with food production, conservation and distribution. The territory covered extended from New England to Florida and from the Atlantic Coast west to Illinois and Texas.

Another series of exhibitions was carried out jointly with the departments of War, Navy, and Interior, the Food Administration and the Committee on Public Information, fair and exposition associations cooperating. The exhibits filled eleven large freight cars. These were divided into six lots and sent out on as many circuits, each circuit in charge of an expert from the Department of Agriculture. When installed the exhibits in each circuit filled a floor space of from 8,000 to 10,000 feet.

The public everywhere manifested a keen interest in these displays. They were made the "feature exhibit" of the fairs and were admittedly the drawing card that brought the record-breaking crowds.

Exhibits Instruct Crowds at Fairs

Following are the places at which the Department of Agriculture exhibits of the first series were shown:

Place	Fair	Date
Cleveland, Ohio	Industrial Fair and Exposition	Sept. 1-9, 1917.
Topeka, Kans.	Topeka, State Fair	Sept. 10-15, 1917.
Berlin, Conn.	Conn. State Fair Society	Sept. 10-15, 1917.
Hutchison, Kans.	The Kansas State Fair	Sept. 17-22, 1917.
Witchita, Kans.	International Wheat Show	Oct. 1-15, 1917.
New York, N.Y.	New York Electrical Expositions	Oct. 10-20, 1917.
Dallas, Texas	State Fair of Texas	Oct. 13-28, 1917.
Meridian, Miss.	Miss. - Alabama Fair	Oct. 15-20, 1917.
Columbus, Ohio	National Dairy Show	Oct. 18-27, 1917.
New Orleans, La.	National Farm & Live Stock Show	Nov. 10-17, 1917.
Shrewsbury, La.	Jefferson Parish Fair	Nov. 21-25, 1917.
Kansas City, Mo.	The Greater Poultry Exposition Association	Nov. 26, Dec. 2, 1917.
Chicago, Ill.	The Chicago Poultry Show	Dec. 4-9, 1917.
New York, N.Y.	Annual Poultry Show	Dec. 28-Jan. 2, 1918.
Springfield, Ill.	The Centennial Poultry Show	Dec. 28-Jan. 2, 1918.
Cleveland, Ohio	Cleveland Pure Food Show	Feb. 4-9, 1918.
Chicago, Ill.	Patriotic Food Show	Jan. 5-13, 1918.
Peoria, Ill.	Illinois State Poultry Show	Jan. 18-22, 1918.
Jacksonville, Fla.	State Fair of Florida	Feb. 26-Mar. 9, 1918.
Baltimore, Md.	Patriotic Food Show "Over There"	Apr. 1-30, 1918.
New York, N.Y.	Nat'l Milk & Dairy Farm Expo- sition	May 20-27, 1918.
Baltimore, Md.	War Food Bureau	June 3-15, 1918.
New York, N.Y.	Patriotic Food Show	June 14-22, 1918.

Window Shows and Other Special Exhibits

New York, N.Y.	Conservation Exhibit & Window display	Aug. 1-30, 1917.
Lancaster, Pa.	Canning and Food Conservation	Aug. 20-27, 1917.
New York, N.Y.	Window Show and Hall Exhibit	Sept. 10-20, 1917.

Window Shows Only

York, Pa.	Canning	Aug. 27-Sept. 6, 1917.
Brooklyn, N.Y.	Food	Sept. 3-10, 1917.
Washington, D.C.	Canning	July, 1917.
Baltimore, Md.	Canning	July, 1917.
Washington, D.C.	Conservation	Nov. 1-6, 1917.

Second Series of Fair Exhibits

The joint Government exhibits the second series, were shown as follows:

Place	Fair	Date
CIRCUIT NO. 1		
Sedalia, Mo.	Missouri State Fair	Aug. 10-17, 1918.
Des Moines, Iowa	Iowa State Fair	Aug. 21-30, 1918.
Hamiline, Minn.	Minnesota State Fair	Sept. 2-7, 1918.
Milwaukee, Wis.	Wisconsin State Fair	Sept. 9-14, 1918.
Oklahoma City, Okla.	Oklahoma State Fair & Exposition	Sept. 21-28, 1918.
Wichita, Kans.	Wichita International Exposition	Sept. 30-Oct. 12, 1918.
Waco, Tex.	Texas Cotton Palace	Nov. 2-7
CIRCUIT NO. 2		
Erie, Pa.	Erie Exposition	Aug. 19-26, 1918.
Rochester, N.Y.	Rochester Exposition & Horse Show	Sept. 2-7, 1918.
Syracuse, N.Y.	New York State Fair	Sept. 9-14, 1918.
Berlin, Conn.	Connecticut State Fair	Sept. 24-28, 1918.
Trenton, N.J.	Interstate Fair Ass'n.	Sept. 30-Oct. 4, 1918.
CIRCUIT NO. 3		
Springfield, Ill.	Illinois Centennial State Fair	Aug. 9-24, 1918.
Detroit, Mich.	Michigan State Fair	Aug. 30-Sept. 8, 1918.
Nashville, Tenn.	Tennessee State Fair	Sept. 16-21, 1918.
Memphis, Tenn.	Memphis Tri-State Fair	Sept. 21-28, 1918.
Knoxville, Tenn.	East Tennessee Division Fair	Oct. 7-12, 1918.
Atlanta, Ga.	Southeastern Fair Ass'n.	Oct. 12-18, 1918.
Macon, Ga.	Georgia State Fair	Nov. 10-18, 1918.
Valdosta, Ga.	Georgia-Florida Fair	Nov. 18-23, 1918.
Jacksonville, Fla.	Florida State Fair & Exposition	Nov. 27-Dec. 7, 1918.
CIRCUIT NO. 4.		
Columbus, Ohio	Ohio State Fair	Aug. 26-31, 1918.
Indianapolis, Ind.	Indiana State Fair	Sept. 3-7, 1918.
Topeka, Kans.	Kansas Free Fair	Sept. 9-14, 1918.
Hutchinson, Kans.	Kansas State Fair	Sept. 16-21, 1918.
Muskogee, Okla.	Oklahoma Free State Fair	Sept. 30-Oct. 5, 1918.
Kansas City, Mo.	International Farm Congress	Oct. 16-26, 1918.
CIRCUIT NO. 5.		
Lincoln, Nebr.	Nebraska State Fair	Sept. 1-6, 1918.
Douglas, Wyo.	Wyoming State Fair	Sept. 10-14, 1918.

Pueblo, Colo.	Colorado StateFair	Sept. 23-28, 1918.
Salt Lake City, Utah	Utah StateFair	Sept. 29-Oct. 5, 1918.
Los Angeles, Calif.	California Liberty Fair Association	Dec. 7-14, 1918.

CIRCUIT NO. 6.

Springfield, Ill.	Illinois Centennial State Fair	Aug. 9-24, 1918.
Huron, S. Dak.	South Dakota State Fair	Sept. 9-14, 1918.
Lemmon, S. Dak.	Interstate Fair Ass'n.	Sept. 18-20, 1918.

SUPPLEMENTARY TO CIRCUITS

Baltimore, Md.	Baltimore News Food Show, Feb. 6-15, 1919.
Baltimore, Md.	Southern Commercial Congress, Dec. 8-15, 1918.
Akron, Ohio	First-Second National Bank, Jan. 6-20, 1919.
Pittsburgh, Pa.	Poultry Exhibition of Pittsburgh, Jan. 13-18, 1919.

THE OFFICE OF INFORMATION

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The Office of Information, being the purveyor of the department's news to the press of the Nation, the translator of its scientific knowledge into the language of the layman, carried the responsibility throughout the war of disseminating very promptly to the people of the country all the information that the department could furnish as to means of increasing food production and promoting food conservation. Its work was intensified and increased not only, but branched into new lines. Before the beginning of American participation in the war, the Office of Information had sought, almost exclusively, to convey its message to country people. After that event, it was just as necessary that the message be heard by urban people, too.

To reach the people of the cities and towns, indeed, was one of the earliest and largest war-time tasks performed by the office. At the very beginning it was apparent that food thrift, the saving of food by every reasonable means, was one of the basic necessities for winning the war. The Office of Information began the crusade immediately after the declaration that a state of war existed. Everything was ready, in fact, for the launching of the crusade even before the declaration was made. During the few weeks following April 7, 1917, the Office of Information put before the readers of the Nation the fact that food saving was a necessary war measure, that, in the final analysis, food would win the war. When the Food Administration was created, it took over, in large measure, the task of promoting food thrift, but the Office of Information continued throughout

the war, in connection with its other duties, to keep the necessity for food conservation before the readers of daily and weekly newspapers, farm papers, trade papers, household and other publications.

During the first three months of the war, 237 articles on emergency subjects were issued to the press. Of these, 51 dealt with the elimination of food waste in the home and conserving perishable products by canning and drying, 45 with the proper handling of field crops to meet the emergency, 26 with the live-stock situation, 10 with the necessity for increase of poultry, and 26 with methods of combating crop pests and diseases. The emergency began after planting was well advanced in the southern half of the country, but until the end of the planting season, special attention was given to increasing the acreage of such food crops as spring wheat, corn, oats, rye, barley, potatoes and vegetables in home gardens. Many articles were issued urging people to eat more corn, to use it as a substitute for wheat.

To accomplish the necessary extension of services, the established channels of the office for distributing informational publicity to the agricultural, newspaper and magazine press were enlarged and new features developed. The Special Information Service, the Home Garden Series, the Canning-Drying Series, and the War Work Weekly were inaugurated.

Valuable Articles Issued Through Press

The Special Information Service was an illustrated weekly news service under four departments of two columns each, in which were discussed war problems of food production and conservation, especially as they related to city people and small producers. The four departments were: "Our Part in Feeding the Nation," "Helping the Meat and Milk Supply," "A Bird in

the Hand," (poultry), and "The Housewife and the War." This service, developed in October, 1917, has been furnished to 7,450 newspapers and probably reached 15,000,000 to 20,000,000 readers weekly. It was continued in slightly different form after the war.

The Home Garden Series was issued early in the season of 1918 to give accurate advice to the home gardeners on the farms and in the cities which would aid them in producing ample supplies of home-grown foods. The material in this series - 37 columns - was sufficient to enable newspapers to carry timely gardening information in detail throughout the season. It was illustrated by cuts, mats, and photographs lent by the department. The series was supplemented during the producing season by timely mimeographed items discussing phases of the work arising from special conditions or developments. A second Home Garden Series was issued in the spring of 1919.

The Canning-Drying Series followed the Home Garden Series as a supplementary service intended to encourage and insure the saving of food produced in the home gardens. It was handled in the same manner as the Home Garden Series, proofs of the 22 columns of material being sent to all dailies in advance of the season and illustrations furnished on request.

The War Work Weekly, a clipping sheet issued under the head "What the Department of Agriculture is Doing," was established in the spring of 1918. Through this service, newspapers and agricultural journals were advised week by week of results and progress obtained by the department's workers and its cooperating forces in the States in war emergency activities chiefly, but also of useful information obtained in the regular work of the department. In reporting progress in meeting the farm labor situation, this service acted as an exchange for successful ideas and plans used in the various States. Because the items in it were limited to 100 words, the War

Work Weekly was an answer to the insistent demand of editors for brevity, on account of space limitations enforced by paper conservation and other war economy measures in publishing. The War Work Weekly was sent to the agricultural, daily and weekly press, and as the Food and Farming Weekly it was continued after the armistice.

Circulars, posters, and other advertising matter were used liberally in the various campaigns of the department. Illustrated announcements advertising certain of the department's Farmers' Bulletins were prepared and used widely in the advertising columns of the daily and weekly press. Through the Division of Advertising of the Committee on Public Information, special advertising campaigns calculated to stimulate production or conservation of farm products were carried on through the medium of free space patriotically offered to the Government by advertisers and by publishers. Campaigns to increase poultry production and consumption and to obtain supplies of farm labor were conducted. Page advertisements in a number of popular magazines, for example, carried to city people the message of the farm labor needs. The office also assisted in the preparation of the United States Food Leaflets, 20,000,000 of which were distributed by the department.

Direct Circulation Reaches Millions

The Weekly News Letter, the official publication of the department, was enlarged from 8 pages to 16 pages on occasions. The News Letter's circulation of 130,000 included newspapers and other publications, Federal and State agricultural workers and cooperators, agricultural leaders, libraries and chambers of commerce. As the official organ of the department, the News Letter carried material intended to further national agricultural campaigns and published the official statements of the department. Popular articles discussing experimental results and advice on agricultural methods also

were used and in more detail than in other news channels of the office.

Through the plate service, the Office of Information prepared agricultural news matter for distribution to the weekly and small daily press. During the war, the output of matter was tripled. This service, which is illustrated, is used in plate form by more than 1,000 weeklies and small dailies and in ready print by about 5,000 weeklies.

By its mimeographed news service, the office furnished daily or as the necessity for prompt distribution demanded, timely press notices to press associations, correspondents, newspapers, agricultural journals, and specialized publications generally or locally. The amount of material issued through this channel was approximately doubled.

Conferences were held with agricultural editors to determine their needs for information from the department, to acquaint them with the department's production campaigns, and to obtain their suggestions and enlist their cooperation in improving the department's informational activities. The needs of the farm press also were obtained in an extensive questionnaire in which editors were invited to express their needs in detail and to give other information useful to the department in developing an agricultural syndicate. Through this syndicate, special feature articles on the more important projects of the department were furnished exclusively to one journal in a section by the use of rotation lists.

To obtain adequate publicity for the recommendations of conferences in the field, the office detailed representatives to attend meetings and to give out information to the press.

THE INSECTICIDE AND FUNGICIDE BOARD

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The Insecticide and Fungicide Board, in collaboration with the Bureau of Chemistry and the Bureau of Entomology, assisted a number of war agencies in important tasks.

For the subcommittee on medical entomology of the National Research Council, the board made chemical examinations, laboratory tests and practical tests at Army cantonments with various remedies for body lice, and with other insecticides used by the Army and Navy against other insects. The results of this work were used by the committee on medicine of the National Research Council in recommending the most effective insect killers.

The board cooperated with the Food Administration in enforcing the provisions of the Food Control Act relating to insecticides, and supplied to that body information on various subjects. A representative of the board was present as advisor of the Food Administration in conferences with insecticide manufacturers. As a result of these activities, the producers' price of white arsenic was reduced from 12-16 cents to 9 cents for carload lots and $9\frac{1}{2}$ cents for shipments of less than a carload, resulting in lower prices for various spraying materials, such as Paris green, lead arsenate, calcium arsenate and other arsenical insecticides.

The board cooperated with the Wood Chemical Section of the Raw Materials Division, Council of National Defense, in arranging for the release of acetic acid, so greatly needed in the airplane program, by substituting vinegar for acetic acid in the manufacture of Paris green. Representatives of the board sat with the committee of the Council of National Defense in

conferences with manufacturers of Paris green.

For the War Department, the board assisted in making tests of the Megan fumigating apparatus to determine whether it, with the formula suggested, could be used for destroying body lice and their eggs and pathogenic bacteria in clothes. The apparatus and formula were found to be not effective.

A member of the Insecticide and Fungicide Board served throughout the war as a member of the Joint Information Board on Minerals and Derivatives.

THE LIBRARY

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The most noticeable effect of the war on the regular work of the library of the Department of Agriculture was in the Reference and Loan Divisions. This was due to two causes. First, the war activities of this and other Government departments, which gave rise to many new lines of investigation, and second, the creation by the Government of various new offices and bureaus for the propagation of the work of the war. All of these new offices needed library facilities in a greater or less degree, and none was provided with them to the extent of its needs. This put upon the established libraries of the Government the responsibility of supplying the new wants in so far as they were able, and, of necessity, greatly increased the volume of work. This library was called upon to do its full share in meeting these new demands.

The Food Administration made very frequent use of the facilities of the main library and also of the branch libraries. Without the resources of this library to draw upon, it would have been considerably hampered in some of its research work. Among the other Government offices which used the library may be mentioned the American University Experiment Station of the War Department, the Edgewood Arsenal and other branches of the Chemical War Service, the Ordnance Department, the committee on Public Information, the Federal Board for Vocational Education, the Division of Export Licenses and other offices of the War Trade Board, various divisions and offices of the Council of National Defense, including the Women's Committee, the Shipping Board, and the War Industries Board.

In addition to meeting these increased demands along the line of its normal and regular duties, the library endeavored to render assistance in other war activities of the Government by lending two of the library assistants to the committee on Public Information for the work of preparing an information file of Government activities and officials.

The librarian was appointed in June, 1917, as chairman of the American Library Association food information committee, and, in that capacity as well as through the library, endeavored to aid in various ways in the work for food conservation and increased production. In August, 1917, a circular letter was sent to the public libraries of the country calling attention to the opportunities for libraries to serve in this work. A second letter was sent in April, 1918. Lists on food subjects were also prepared and publications of the department on these subjects were sent in quantities to libraries for distribution.

In the line of war publications, the library issued a series of seven Library Leaflets as follows: No. 1, "Raise Chickens;" No. 2, "Raise Pigs;" No. 3, "Raise Sheep;" No. 4, "Bread and Cereals;" No. 5, "Vegetables and Fruits;" No. 6, "Meat and Meat Substitutes;" No. 7, "Fats and Sugars."

The leaflets were issued to help in the work of increased food production and conservation.

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THE OFFICE OF FERTILIZER CONTROL

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The fertilizer industry of the country was placed under license control, following a proclamation by the President on February 25, 1918, the object being to secure an adequate supply of fertilizers to grow the crops most needed during the war. The work was done by the office of Fertilizer Control, created in the Department of Agriculture as an emergency organization.

Of the three main elements of commercial fertilizers, the United States was independent only as to one. The supply of phosphate rock was adequate, but the means of transportation from the mines to the mixing plants were limited and somewhat uncertain. Prior to the war, the United States had been dependent upon Germany for practically all of its potash and upon the Chilean deposits for most of its nitrates. These supplies were cut off, the one as a direct result of the war and the other, largely, by the shortage of shipping facilities. Important fertilizer materials, particularly nitrate of soda, ammonium sulphate and sulphuric acid, were required to a great extent for the manufacture of munitions.

The firms engaged primarily in manufacturing fertilizers were placed under license immediately after the President issued his proclamation. Many important fertilizer ingredients, however, are by-products of other industries, and considerable time was necessary to complete the necessary work for bringing these under control.

One of the first large results of control was the "thirty-ton agreement." Before that time, fertilizer manufacturers had made lower prices to dealers

than they would make to individuals or farmers' associations purchasing in wholesale quantities. Under the "thirty-ton agreement," manufacturers bound themselves to charge the same prices in wholesale lots of not less than 30-ton carloads or such other carload unit as might be fixed by the Car Service Section of the Railroad Administration.

Fertilizer Benefits to be Permanent

The United States will come out of the war much more nearly able to meet its own fertilizer needs than when it went in. The office of Fertilizer Control investigated the fertilizer requirements of the country, the available supplies of fertilizer ingredients, the potential sources of fertilizers and methods employed both in the production of raw materials and mixed fertilizers. Means were found for increasing the production of important ingredients. The production of ammonium sulphate, one of the important materials for supplying nitrogen, was increased 50 per cent by the installation of by-product ovens at cooking plants, and it is believed that in another year the needs of the fertilizer industry will be fully met.

Sufficient domestic potash to meet the Nation's needs is not yet in sight, but a substantial beginning has been made. The normal potash requirement of the country is about 240,000 tons. The principal sources of supply at present are the natural brines of Searles Lake in California, and the Nebraska lakes. Other sources are in process of development. The dust escaping from cement works is capable of producing 70,000 tons a year and will yield, perhaps, 10,000 tons this year. Blast furnaces, also, can recover large quantities of potash as a by-product, but they are not yet as well developed as the cement works. Some silicates, especially the green-sand deposits of New Jersey, the sericite shales of Georgia and the leucite rocks of Wyoming, may become important sources of potash. The Department

of Agriculture demonstrated, during the war; the possibility of obtaining high-quality potash from the giant kelps of the Pacific Coast, but the cost of manufacture is high and the location is unfavorable. This source is not likely to furnish a permanent peace-time supply. On the whole, however, the prospects of developing a permanent potash industry are very promising, and it is certain that the United States never again will be wholly dependent upon an enemy for supplies of this important fertilizer material.

A complete survey of the fertilizer situation was made, together with special inquiries on subjects of particular interest. Because of the importance of nitrate of soda and sulphate of ammonia as fertilizer ingredients, monthly reports were required from all dealers in these commodities, from all producers of ammonium sulphate and from fertilizer mixers showing their consumption and stocks.

In cooperation with the Bureau of Crop Estimates, an investigation was made to determine the prevailing custom in the use of fertilizers on different crops in the different parts of the country. A similar study was made of the manure used on crops. This information has been put in permanent form and will be of use when work is begun toward finding a thoroughly scientific basis for agricultural practice with regard to fertilizers.

Stabilizing Fertilizer Market

After compilation of the necessary information as to the available supply of fertilizers and fertilizer ingredients and on requirements, a section on distribution was organized and supervised the allocation of fertilizers to the different crops and to the various sections of the country.

The office was frequently called upon to decide whether or not exports or imports of fertilizers should be authorized by the War Trade Board. On

questions of export, the decision depended upon whether there was a surplus and whether the fertilizer in question was to be used in the production of a crop that was scarce and of value to this country and the Allies. On questions of imports, the office was guided largely by the need of the material as compared with other uses for the available shipping space.

Problems relating to the transportation of fertilizers were handled in cooperation with the Railroad Administration. Efforts were made to provide sufficient car service for the phosphate mines in Florida and to promote movement early in the season when traffic conditions were better. Arrangements were made with the Priorities Board, the Fuel Administration and the Railroad Administration to provide sufficient fuel for the Nebraska potash plants. Numerous other cases of arranging for transportation facilities were dealt with. A great deal was done, in the interest of car conservation, to encourage fuller loading of freight cars.

Detailed studies were made to provide the necessary information for dividing the country into fertilizer zones, which would have become necessary if hostilities had continued.

THE OFFICE OF FARM EQUIPMENT CONTROL

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During the war, the Department of Agriculture exercised, through an emergency office, control over the farm equipment industry of the country. The authority for such control was contained in the Food Control Act of August 10, 1917. Congress regarded it as necessary to prevent scarcity, monopoly, hoarding and injurious speculation and to secure the necessary distribution. The President was authorized, whenever he should find it essential, to make such regulations as necessary and to institute a licensing system covering importation, manufacture, storage and distribution of farm machinery, used in the production of food and feed, implements and tools. The President, on May 14, 1918, issued a proclamation putting the licensing system into effect and designating the Secretary of Agriculture to carry it into effect.

The purpose of the system was to insure an adequate supply of farm equipment at fair prices. Licensees were prohibited from handling any farm equipment at an unreasonable or discriminatory profit. All resales tending to result in higher prices were forbidden. All attempts at restricting the supply, either locally or generally, through monopolistic handling were forbidden. Licensees were required not to permit waste or any preventable deterioration in connection with the importation, manufacture, storage, distribution or sale of farm equipment. They were forbidden also to make any misleading statements tending to increase the price of any equipment. All quotation of prices and statements about equipment were required to be capable of verification from the records of the dealers, manufacturers and others.

Representatives designated by the Secretary of Agriculture had access to the plants, offices and stores of manufacturers, dealers and others engaged in the handling of farm equipment, could inspect the factory or store, examine the books and other records and, if deemed necessary, require sworn statements from licensees.

Oversight was maintained from the factory to the farm. The county agents and employees of the Department of Agriculture cooperated in gathering information as to the prices farmers were paying and had been paying for the past five years for equipment.

The result was that the farm equipment industry was operated on a fair margin of profit, a sufficient supply was turned out and properly distributed . and the farmer bought his equipment at a just price.

No actual reduction of the needful supply of farm machinery and equipment was at any time necessary. Materials were, at times, very scarce, but elimination of patterns little used, and looking after the repairing of old equipment more carefully was found to be an effective remedy. In a few instances, there were cases when farmers were not able to get just what they required but in most cases there was a complete supply of all the necessary patterns of farm equipment. The capacity of the manufacturers was ample and the reduction in the supply of raw material by reason of the war requirements was of such short duration that there was practically no shortage in the supply of equipment.

EMERGENCY WAR WORK WITH SEED

Immediately after the entrance of this country into the war, the Department of Agriculture received floods of inquiries as to where seed could be purchased or obtained gratis. The emphasis that had been laid upon the food situation was very largely responsible for the insistent demands for information regarding seed and seed stocks.

In order that the department might be in a position to give as much information as possible, the Secretary under date of April '21, 1917, appointed a committee on Seed Stocks, consisting of eight persons.

The committee was ordered to secure full information regarding available seeds and seed stocks for staple food crops including corn, wheat, oats, barley, rye, potatoes, flax, beans, peas, soy beans, Kafir, milo, and sweet sorghums, and the needs of special localities or regions for such seeds. It was directed also to consider questions relating to the growing and distributing of seed stocks, to ascertain the quantity and price of seeds available and the probable shortages in particular regions, and to advise as to means for meeting such shortages.

The committee at once proceeded to take an inventory of the Nation's seed stocks. It had at its disposal the well-organized machinery of the Bureau of Crop Estimates, with its large corps of crop reporters, the machinery of the Extension Service, the newly organized marketing section of the Bureau of Markets, the inspection forces of the Bureau of Chemistry, and the crop experts of the Bureau of Plant Industry. For the first time in its history, the Department of Agriculture obtained a close and accurate view of the country's seed supply.

Early in its history, the committee was confronted with the need for a general program of production, in order that it might take steps to encourage the saving of seed of certain staple crops. In the case of flax it was found that the readily available supply of good seed for the spring of 1917 was apparently inadequate to sow an acreage sufficient to produce seed for domestic crushing needs, estimated on the basis of normal demands and much reduced imports. It was decided that at least a normal quantity of flax seed was desired, and a campaign was instituted among grain dealers and oil mills with a view to cleaning and saving seed for sowing a relatively large acreage.

Equalizing Seed Distribution

The information obtained by the committee was helpful in forming and carrying out the department's 1917 program of production. The seed requirements of the various crops, based on normal acreages, were estimated and efforts were put forth to make stocks of good seed as available as possible.

In the first three months of the committee's activities it had impressed upon it the fact that attention can not be called to a shortage of seed with a view to conserving that particular kind without producing a marked tendency to increase the price and encourage speculation. It was found necessary, therefore, to exercise considerable care in this regard.

On August 10, 1917, the Food Production and the Food Control Acts became effective. The Food Production Act carried with it a provision for the purchase and sale of seeds to farmers as follows:

"Sec. 3. That whenever the Secretary of Agriculture shall find that there is or may be a special need in any restricted area for seeds suitable for the production of food and feed crops, he is authorized to purchase, or contract with persons to grow such seeds, to store them, and to furnish them to farmers for cash, at cost, including the expense of packing and transportation."

"Sec. 8 * * * * * For procuring, storing, and furnishing seeds, as authorized by section three of this Act, \$2,500,000, and this fund may be used as a revolving fund until June thirtieth, nineteen hundred and eighteen."

Congress added \$4,000,000 to the appropriation for the emergency purchase and sale of seed by a provision in the Urgent Deficiency Act, March 26, 1918.

Remedying Drought Damage

The most important activities of the committee on Seed Stocks and those which had the most direct bearing on the seed supply were undertaken under the provisions of these acts.

In the summer of 1917 severe damage resulted to crops from drought, especially in parts of Texas, North Dakota, and Montana, and in Oklahoma and Kansas. By midsummer it became evident that many counties in these States would not produce seed enough to plant their normal acreages the following year. The situation became quite alarming and, because of the precarious condition of the world's food supply, more or less hysteria prevailed. The department and State officials made as careful surveys of the seed situation as possible in the counties where the drought was most severe, and it was decided to use the funds and authority conveyed in the Food Production Act to relieve the apparent emergency. The committee on Seed Stocks, in taking up the emergency purchase and sale of seed, had the following objects:

1. To conserve seed that was badly needed in a particular locality from being used for food or feed or in any way passing out of availability to the locality where it was produced and where it was badly needed.

2. To insure an adequate supply of good seed for sections where an insufficient quantity was produced.

3. To assist agencies that were undertaking to finance farmers in the purchasing of seed by making it possible for them to depend upon a definite supply at nearly a fixed price.

4. To prevent speculation in seed and to hold prices to a fair level.

After considering the needs and recommendations of the drought-stricken areas, arrangements were made for the purchase and sale of seed in Texas, Oklahoma, Kansas, North Dakota, and Montana. Seed of corn, cotton, the sorghums, and peanuts was purchased for Texas; sorghums for Oklahoma and Kansas; and barley, oats and flax for North Dakota and Montana.

The severe drought of the summer of 1917 was not the only factor that proved detrimental to the seed supply of the country. On account of the very late season and the early frosts and freezes, incalculable damage was done to the corn crop, and the supply of good viable seed corn produced in the northern part of the Corn Belt was far from sufficient for planting requirements. This was the greatest emergency in seed supply during the period of the war. The committee on Seed Stocks recognized the seriousness of the situation early in the season and did what it could to call attention to the necessity of conducting seed-corn saving and testing campaigns. In this connection, the work of the State institutions, especially the extension services of the various States, was admirable and productive of excellent results. It soon became apparent, however, that something more than seed-corn saving and testing campaigns was necessary, and the department was called upon to allot funds from the appropriation for the purchase and sale of seed conveyed in the Food Production Act. Allotments were made, especially for Ohio, Indiana, Michigan, North Dakota and Iowa. Since a sufficient supply of local seed corn could not be had in all cases, the committee, in cooperation with the State officials, arranged for the im-

portation of lots of seed from other localities. One of the largest experiments in seed-corn acclimatization ever attempted was conducted. Seed corn from Pennsylvania and Delaware was shipped to Ohio and Michigan, and from New Jersey to Indiana. It was impossible to get seed corn or varieties nearly adapted to North Dakota conditions except in the New England States, and several cars were shipped from Rhode Island and Connecticut. The results proved highly satisfactory, the long and favorable growing season of 1918, possibly having much to do with the outcome.

Reserve Seed Supply Kept.

As the planting season approached, the department was urgently requested to use the funds at its disposal to provide a reserve supply of seed corn of late planting and replanting. Some of the local financial agencies that were assisting in providing corn for the first planting could not use their funds to provide a reserve for replanting. They could purchase corn only as orders were received for it. It was concluded by the department, after carefully considering the situation, that the importance of insuring a large acreage of corn was sufficient to warrant the risk that might be taken in buying seed for a replanting reserve.

The seed purchased by the department for first planting was all sold to farmers for cash at cost, but a rather large percentage of that purchased for reserve was not called for, since the weather throughout the entire Corn Belt was so favorable during the planting season that the replanting requirements were very far below normal.

In its emergency purchase and sale of seed there was sold by the department a sufficient quantity for planting approximately 1,200,000 acres. The department did not sell all the seed it purchased. It was

handicapped to some extent by the wording of the law, which made it necessary to sell at cost and therefore allowed no margin to take care of declining prices. In the drought-stricken areas of the Southwest, the drought continued so late in the spring of 1918 that the demand for seed at the normal seeding time was greatly reduced, and this, together with the fact that the supply of seed, especially of the sorghums, was appreciably greater than had originally been estimated, caused by a decided break in the sorghum-seed market. Speculators in a panic offered their stocks for sale much below cost.

Several points were clearly brought out in connection with the emergency purchase and sale of seeds, probably the most important being that high prices go far toward overcoming shortages. It is really remarkable how much seed will be placed on the market as the result of very attractive prices.

The authority to purchase and sell seed to farmers for cash at cost provided in the Food Production Act of August 10, 1917, was continued in an act with the same title for the fiscal year 1919. The wording of the provision was changed somewhat and is as follows:

"For procuring, storing, and furnishing seeds, as authorized by section three of the act, the appropriations for said purposes of \$2,500,000 in section eight of the Act and \$4,000,000 under the heading 'Department of Agriculture' in the Act approved March twenty-eighth, nineteen hundred and eighteen, entitled 'An Act making appropriations for the fiscal year ending June thirtieth, nineteen hundred and eighteen, and prior fiscal years, on account of war expenses, and for other purposes', shall be available until the date when said Act of August tenth, nineteen hundred and seventeen, shall cease to be in effect, and any moneys heretofore or hereafter received by the United States for furnishing such seeds may be used as a revolving fund."

A large part of Texas sustained in 1918 severe damage to crops as the result of droughts even more destructive in nature than those of 1917.

An emergency was produced in certain sections in connection with the supply of suitable seed corn. Because of the benefit accompanying the department's emergency purchase and sale of seed corn in Texas in 1918, State officials and public-spirited individuals urged the department to assist in the same manner as the previous year. The sum of \$75,000 was allotted for this work from the funds appropriated for the purchase and sale of seed to farmers in the Food Production Act, 1919, and arrangements made to purchase and sell corn as was done in the fiscal year 1918. Approximately 10,000 bushels was purchased.

Insuring Price of Wheat

Another function which the Committee on Seed Stocks was called upon to perform under the emergency legislation developed with the fixing of the price of wheat. After the price of wheat was fixed, the Grain Corporation, a subsidiary branch of the United States Food Administration, formulated and promulgated regulations to maintain a fixed price level and to control the movement of the wheat supply of the country. There was a provision against the storing of wheat in elevators and warehouses for a period longer than 30 days. It was soon found that if this was strictly enforced it would seriously interfere with the storage of seed wheat, especially in the spring-wheat areas and in the sections where winter wheat is sown before the crop of the same year is available, notably in the Judith Basin and other parts of the Northwest. The regulations did not go into effect in time to interfere with the holding of seed of winter wheat for the 1917 sowing. In a conference between members of the Grain Corporation and the Committee on Seed Stocks, a plan was developed whereby seed wheat and seed rye (rye likewise being largely under the control of the Grain Corporation) could be held until after the sowing season had passed. The

plan was briefly this: A dealer wishing to hold wheat or rye for seed was required to apply to his zone agent, who was the Grain Corporation's representative in his zone, for a license to store these seed grains. If he was in good standing with the Food Administration, his application was approved and he was instructed to submit samples of the lots he desired to store to the laboratory of the Committee on Seed Stocks in his State or zone. These samples when submitted were examined, and notification was sent to the dealer and also to the zone agent as to their suitability for seed. In this way, very close supervision was kept of the stocks of wheat and rye held for seed by grain dealers. To stimulate the holding of a sufficient quantity of seed and in recognition of the cost of storing and handling it, the Grain Corporation allowed the dealers to charge not in excess of 15 per cent above the Grain Corporation's price for the same grade of wheat at their shipping points.

The handling of these samples entailed quite a lot of work, which was done at four points: At Minneapolis, in a laboratory established especially for the Committee on Seed Stocks; at Pullman, Washington; Moscow, Idaho; and Corvallis, Oregon, in cooperation with the State agricultural colleges. Thousands of samples were examined, and upward of a million bushels of wheat approved and stored under this plan in 1917-18. The Grain Corporation changed its plan of maintaining price levels for the crop of 1918, and the regulation limiting the storage of wheat to 30 days was abolished.

Making Good Crop Failures

Crop failures made stocks of good seed wheat scarce in parts of North Dakota and Montana, and the desire to increase the acreage of spring wheat in the spring of 1918, especially in the margins of the spring-wheat area, made it necessary to devote considerable attention to the seed supply.

The Grain Corporation, upon the recommendation of the committee on Seed Stocks, stored seed wheat at points tributary to the areas where the crop of the preceding harvest was short and also shipped it into the twilight areas where the tendency to sow indicated a demand for seed in excess of the supply. Approximately 500,000 bushels was provided for such areas through this cooperative activity.

The committee was called upon to cooperate with the War Trade Board and especially to supply information that would help in shaping intelligent export and import policies. It was found necessary to recommend the laying of temporary embargoes in a few cases and to advise the restriction of exports, especially to northern neutral countries that were asking for seed far in excess of their normal net importations. In December, 1918, a temporary embargo was placed on the exportation of red-clover seed because of the apparent insufficiency of the available supply for home needs in the spring of 1919. This embargo remained until January 15, 1919, after which, as a result of more complete data, it was modified to permit the exportation of 3,000,000 pounds of seed to the allied countries and 2,000,000 pounds to the northern neutral countries.

SEED GRAIN LOANS IN DROUGHT-STRICKEN AREAS

In the summer of 1918, representations were made that many wheat growers in certain sections of the West might be compelled to forego fall planting and even to abandon their homes unless given immediate aid. They had lost two successive crops by winter killing and drought and had exhausted their resources.

At the suggestion of the Secretary of Agriculture, the President on July 27, placed \$5,000,000 at the disposal of the Treasury Department and the Department of Agriculture to assist in tiding the farmers in drought-stricken areas over the period of stress, to enable them to remain on their farms and to plant such acreages as was deemed wise under all the conditions, to add to the National security and defense.

The Federal Land Banks were designated as the agents of the Government to make and collect the loans. The cooperation of local banks was secured in the taking of applications and in temporarily financing farmers pending advances of Federal funds. Assistant Secretary G. I. Christie was designated to represent the Department of Agriculture in the Northwest district which included the western portion of North Dakota and portions of Montana and Washington. Mr. C. W. Warburton, Agronomist in the Bureau of Plant Industry, was assigned as his Special Assistant with headquarters at Great Falls, Mont. Mr. Leon M. Estabrook, Chief of the Bureau of Crop Estimates, was appointed assistant to the Secretary to represent the department in the Southwest district, which included portions of western Kansas, Oklahoma, Texas and eastern New Mexico. Mr. H. N. Vinall, Agronomist in the Bureau

of Plant Industry, was assigned as special Assistant to Mr. Estabrook with headquarters at Wichita, Kans. Several field agents were likewise assigned to this work.

Conferences were held with specialists of the State colleges of Agriculture and a list was made of the counties in which it was deemed wise to make loans. County agents represented the Department of Agriculture, inspected the field and verified the sworn statements of applicants. A limit of \$3 an acre on not more than 100 acres was fixed. The farmers agreed to use seed and methods approved by the department. They signed a promissory note for the amount of the loan, with interest at the rate of 6 per cent payable in the fall of 1919, and executed a mortgage giving the Government a first lien on the crop to be grown on the acreage specified. Furthermore, provision was made for a guaranty fund, each borrower agreeing to contribute 15 cents for each bushel in excess of a yield of 6 bushels per acre planted under the agreement. A maximum contribution of 75 cents per acre was fixed. The object of this fund is to safeguard the Government against loss. If it exceeds the loss it will be refunded pro rata to the contributors.

Valuable Assistance to Farmers

It was recognized that there were farmers in the Northwest who would probably be in even more urgent need of assistance for their spring operations. As soon as it was seen that there would be a considerable unexpended balance from the fall planting activities, announcement was made that it would be expended for the spring planting of wheat. Since the cost of seeding spring wheat is greater than that for the fall, it was indicated that the loan would be made on the basis of \$5 an acre, with a limitation of 100 acres.

Number and Amount of Seed Grain Loans During
The Fall of 1918 and the Spring of 1919.

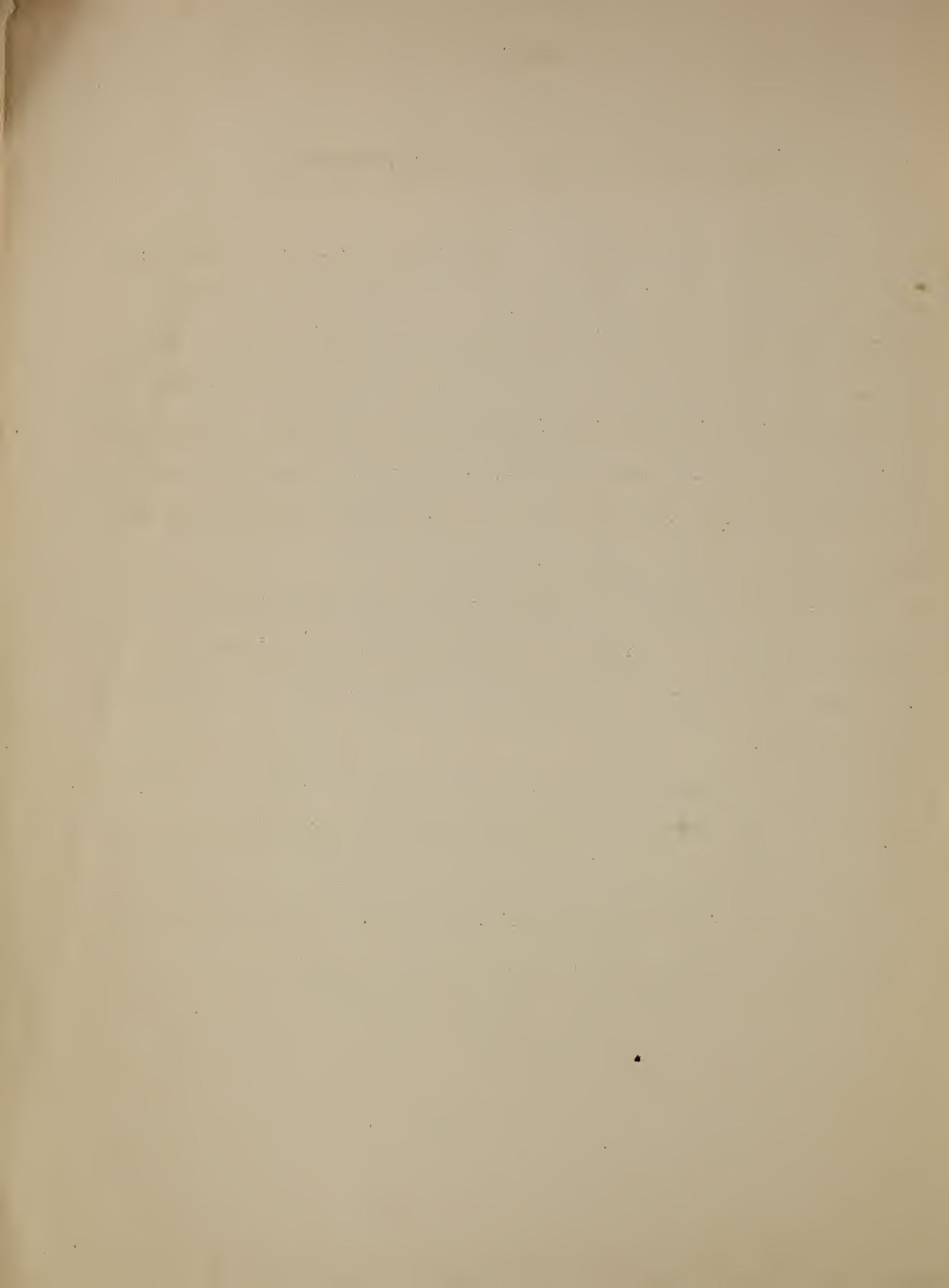
State	Fall Loans		Spring Loans		Total	
	Number	Amount	Number	Amount	Number	Amount
Montana	1,480	\$300,919	5,284	\$1,847,360	6,764	\$2,148,279
North Dakota	338	65,944	1,354	483,567	1,692	549,511
Washington	17	4,335	38	13,970	55	18,305
Texas	1,336	292,651			1,336	292,651
Kansas	3,531	943,147			3,531	943,147
Oklahoma	3,852	773,271			3,852	773,271
New Mexico	87	16,193			87	16,193
Grand Totals					17,317	\$4,741,357

THE NATIONAL AGRICULTURAL ADVISORY COMMITTEE

In March, 1918, the Secretary of Agriculture and the Food Administrator created the National Agricultural Advisory Committee. Both of these officials had felt that in discharging the war responsibilities of food production and food conservation, they stood in need from time to time for consultation with representative agricultural and live-stock producers. The Advisory Committee, therefore, was made up of 24 representatives of all phases of agriculture and live-stock production and of the typically agricultural regions of the United States.

The committee assembled in Washington on March 28 and remained in session until April 4. A number of subcommittees were appointed and assigned to studies of the larger and more critical agricultural problems confronting the Government.

While the committee as a whole was not again in session, it maintained an office at the Department of Agriculture and its subcommittees continued their work until after the signing of the armistice. The work was extremely helpful to the department in solving many of the problems in securing larger production and fuller conservation of food.



THE AGRICULTURAL COMMISSION TO EUROPE

In August, 1918, the Secretary of Agriculture appointed a commission to visit Europe and make a study of agricultural conditions. So far as can be ascertained, this was the only war commission charged with the single duty of investigating the conditions of agricultural production. The primary aim was to discover what could be done to make absolutely certain that, so far as food supplies were concerned, the war would be won. A secondary aim was to ascertain the outlook for agriculture after the war, during the period of reconstruction. In application, the secondary aim became the primary, for the armistice was signed within a few days after the commission completed its work and the reconstruction problems immediately superseded the war problems of agriculture.

The commission was composed of eight men. Four were officials and experts of the Department of Agriculture. Three were officials of agricultural colleges. One was a farmer and specialist in improved plant breeding.

The commission sailed on August 24 and returned November 5. During the interval, a detailed study was made of agricultural conditions in Great Britain and France, together with a less detailed study of Italian conditions. The studies both in England and France were made in cooperation with the Ministers of Agriculture of the two countries. Assistance was given, also, by officials of Oxford and Cambridge in England and by the Institute of Agronomy, the Academy of Agriculture and the Grinnon Agricultural School, and the National Farmers Society in France.

THE HISTORY OF THE
CITY OF BOSTON

The history of the city of Boston is a subject of great interest and importance. It is a city of many centuries, and its history is full of interesting events. The city was founded in 1630, and since that time it has grown to be one of the largest and most important cities in the United States. It has been the seat of many important events, and it has played a large part in the history of the country. The city is known for its many famous landmarks, and it is a city of great beauty and interest. The history of the city is a story of growth and development, and it is a story that is full of many interesting and important events. The city has been a center of commerce and industry, and it has been a city of great importance and influence. The history of the city is a story that is full of many interesting and important events, and it is a story that is full of many interesting and important events.

The reports made by the members of the commission upon their return showed in detail the situation as to crop production and live stock in Western Europe, in what particulars the various countries would be able to meet their own food needs and in what particulars they would require assistance from the United States and other countries before the 1919 harvest. They showed, also, the outlook for planting during the spring of 1919, and were generally helpful in framing the agricultural policies for the United States during the period of reconstruction and readjustment.

